ESU-services

fair consulting in sustainability

2024

Environmental report and product declaration 2023

ESU-services Ltd.

Environmental report and product declaration 2023

Photo: ESU-services office rooms until November 2023 located in the Rheinstrasse, Schaffhausen

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About us	ESU-services Ltd. was founded in 1998. Its core objectives are consulting, coaching, training, and research in the fields of life cycle assessment (LCA), carbon footprints, water footprint in the sectors energy, civil engineering, basic minerals, chemicals, packaging, telecommunication, food and lifestyles. Fairness, independence, and transparency are substantial characteristics of our consulting philosophy. We work in an issue-related manner and accomplish our analyses without prejudice. We document our studies and work transparently and comprehensibly. We offer fair and competent consultation, which makes it possible for clients to control and continuously improve their environmental performance. The company has worked for various national and international companies, associations, and authorities. In some areas, team members of ESU-services performed pioneering work such as development and operation of web-based LCA databases or quantifying environmental impacts of food and lifestyles.
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Abstract

Sustainability is at the core of our consulting activities. With this report, our customers are informed about the measures we take to reduce the environmental footprint of our own consulting services. Furthermore, we show how we work to improve our social and economic sustainability.

In this report, the environmental impacts of our services are calculated and shown in an environmental product declaration (EPD). Business trips are a decisive factor affecting the impacts of individual projects. Therefore, they are calculated separately from the general impacts of the service.

Using this data basis, we can also report the full environmental impacts of our services after finalization of a project.

Train travel is our preferred means of transportation, for both national and international business trips. If it is necessary to use a car, we rely on the car-sharing organization Mobility. Airplane trips and other emissions are not compensated to avoid offering disadvantageous incentives.

Our suppliers are also chosen based on their sustainable performance. For example, we use Fairphones and either recycled or FSC-certified paper. We use naturemade star certified electricity "Naturstrom Schaffhausen" provided by SH power, our local provider.

For pension insurance, ESU-services is a member of the "Abendrot" insurance company, which operates a sustainable investment policy.

Home office or mobile office form an important part of our working location. We offer all staff members the opportunity to work part time in order support families and work-life balance. Salaries are based on talent and not influenced by age or gender. Additionally, we actively discourage structural overtime.

We actively support our customers in developing sustainable business practices. There are special consultancy rates for NGOs. Furthermore, we support all types of media with scientific sound information on life cycle assessment results.

Kurzfassung

Die Schonung der natürlichen Ressourcen und eine nachhaltige Wirtschaftsweise stehen nicht nur im Mittelpunkt unserer Beratungsangebote. Auch für die Führung unseres Unternehmens sind dies wichtige Massstäbe.

Im vorliegenden Umweltbericht werden die Umweltbelastungen, der durch uns angebotenen Dienstleistungen, unter Berücksichtigung aller relevanten Aspekte untersucht. Im Bericht werden dazu die wichtigsten Verursacher der Umweltbelastungen aufgezeigt. Der Bericht dient dazu Verbesserungsmöglichkeiten festzulegen. Mit einer Umweltdeklaration können ausserdem die Umweltbelastungen für die angebotenen Dienstleistungen ausgewiesen werden.

Der Umweltbericht der ESU-services GmbH zeigt, dass die jetzt verursachten Umweltbelastungen pro Beratungsstunde vor allem über Geschäftsreisen beeinflusst werden können. Nach Möglichkeit versuchen wir alle Reisen in Europa mit der Bahn durchzuführen. Für unbedingt notwendige Autofahrten gibt es eine Mitgliedschaft beim Carsharing «Mobility». Flugreisen und andere CO_2-Emissionen werden nicht kompensiert, um falsche Anreize zu vermeiden.

Andere Faktoren wie die Höhe des Energie- und Wasserverbrauchs und Infrastruktur sind nur begrenzt beeinflussbar. Für unseren Strombedarf kaufen wir eine entsprechende Menge Naturstrom Schaffhausen, die mit dem naturemade star Label zertifiziert wurde, von unserem lokalen Versorger SH Power ein.

Für die Rentenversicherung ist ESU-services Mitglied bei der Versicherung „Abendrot“, die eine nachhaltige Anlagepolitik betreibt.

Das Pendeln hängt vom Wohnort der Mitarbeiter ab und ist damit auch eine individuelle Entscheidung. Wir arbeiten teilweise im Homeoffice und per Videokonferenzen und reduzieren so die Anzahl bzw. Distanzen für Arbeitswege und Geschäftsreisen.

Wir unterstützen unsere Kunden bei der Reduktion von Umweltbelastungen. NGO’s wird bei Projekten ein zusätzlicher Rabatt gewährt. Ferner unterstützen wir qualitativ hochstehenden Journalismus in einer Vielzahl von Beiträgen für verschiedene Medien.

Contents

Abbreviations

	Deutsch	English
CH	Schweiz	Switzerland
EPD	Umweltproduktdeklaration	Environmental Product Declaration
ISO	Internationale Organisation für Normung	International Organization for Standardization
LCA	Ökobilanz	Life Cycle Assessment
GWP	Klimaänderungspotential	Global Warming Potential
PCR	Produktkategorie-Regeln	Product Category Rules
RER	Europa	Europe
SH	Schaffhausen	Schaffhausen
UBP	Umweltbelastungspunkte	Eco-points
PEF	Ökologischen Fußabdruck für Produkte	Product environmental footprint

1 The services provided by us

1.1 Our philosophy "fair consulting in sustainability"

The core objectives of ESU are consulting, software, data, training and research in the fields of Life Cycle Assessment (LCA) and carbon footprints. We work for all economic sectors such as energy, food, civil engineering, basic minerals, chemicals, packaging, telecommunication, agriculture and lifestyles. ESU also creates environmental product declarations (EPD) and conduct critical review as well as verifications according to different standards.

The name ESU derives from the German Energie-Stoffe-Umwelt (energy-materials-environment), which covers our main areas of expertise. ESU has been founded in 1998. Our CEO Niels Jungbluth has LCA experience since 1994. Fairness, independence and transparency are substantial characteristics of our consulting philosophy. This means, we work issue-related and accomplish our analyses without prejudice. Our studies and work are documented transparently and comprehensibly. Thus, it is also possible for an outsider to control the quality of our work at any time. We offer a fair and competent consultation, which makes it for the clients possible to control and continuously improve their ecological performance. The same objectives are followed for our own environmental policy.

The company worked and works for various national and international companies, NGOs, associations and authorities. In several areas, team members of ESU-services performed pioneering work or are involved in large projects with industrial partners.

1.2 Wide range of consulting services

ESU-services offers a wide range of services around the topic of life cycle assessment (LCA):

1.2.1 Consulting and case studies on LCA:

- LCA case studies on energy systems, biofuels, food, packaging, lifestyles, transport, electronics, materials, construction products, and many other sectors.
- Environmental declarations (EPD), Product Environmental Profile (PEP), Product Environmental Footprint (PEF) and verification of such statements. Development of Product Category Rules (PCR, PEFCR) for EPDs.
- Balance of a company's total emissions including the flow of goods like an organizational life cycle assessment (OLCA) - or corporate carbon footprint (CCF) according to GHG Protocol Corporate Accounting and Reporting Standard. This is used as a basis for ESRS (European Sustainability Reporting Standards) according to the CSRD (Corporate Sustainability Reporting Directive), other reporting initiatives, or climate target setting.
- Consulting on life cycle and supply chain management.
- Life cycle costing (LCC)
- Ecodesign of products
- Project management in ground-breaking life cycle assessment projects such as ecoinvent and the "Life Cycle Assessment of Energy Products".
- Other assessment methods such as CO_2-balances (carbon footprint), water footprint, environmental footprint, energy analyses, ecological footprint, biodiversity footprint, or transport balances.
- Material and substance flow analyses (MFA and SFA).
- Environmental extended input-output analysis
- Development of impact assessment methods, e.g. method of ecological scarcity (environmental impact points).

- Expertise and Standardisation for life cycle assessment

1.2.2 Software for LCA calculations:

- Support and distribution of the world's leading LCA software SimaPro
- Automation for LCA and EPD calculation and documentation
- Simplified LCA software and applications like parameter models in MS Excel.

1.2.3 Education for environmental managers and the public:

- Training and coaching for LCA software and application.
- Education and training, lectures
- Support for journalists
- Organization of workshops such as the life cycle assessment discussion forum and conferences (International LCA foods conference).

1.2.4 Life cycle inventory data:

- Life cycle inventory analysis, e.g., for oil and gas products for third party databases like ecoinvent, KBOB or CarbonMinds.
- Sales of own and third party life cycle inventory data for various areas of interest (e.g. food production and consumption, energy systems, chemicals or social life cycle assessment).

1.2.5 Review, Verification and Validation:

- Critical review according to ISO 14040, 14044, 14067, and other standards.
- Verification of EPDs according to EN 15804.
- Advice on the development of standards for life cycle assessment.
- Articles for scientific journals, review, editor for the Int J LCA. according to EN 15804

1.2.6 Projects in 2023

See Tab. 1.1 for a list of the most recent and relevant projects conducted in the last year. A full list of about 400 project references can be found on the internet.

Tab. 1.1 Selection of recent and relevant projects done by ESU-services in 2023

Year	Project title	Commissioned by
Since 1996	Presentations about the food production, consumption and environmental impacts	Various
Since 2000	Data-on-Demand: life cycle inventory database for energy, biomass, chemicals and other commodities	Own development
Since 1995	World LCA database for food consumption and production (agriculture, food processing, distribution, consumption)	Own development
Since 1999	Peer Reviews of papers	www.publons.com/researcher/488732/niels-jungbluth
Since 2001	Subject Editor "LCA for Energy Systems and Food Products"	The International Journal of LCA
Since 2006	Training and coaching in LCA and SimaPro	Various
Since 2007	SimaPro Competence Centre Switzerland, Germany, Austria and Liechtenstein	PRé Sustainability, NL
Since 2008	Member of the Scientific Committee and reviewer of abstracts and papers (Niels Jungbluth, PhD)	International Conference on Life Cycle Assessment of Foods
Since 2001	Key parameter models for labelling of electricity, heat, biomethane and cooling from renewable resources with the naturemade star certification	naturemade - Association for environmentally sound energy (VUE)
Since 2014	Individual verifier for the international EPD® System	On request
2019-2023	PROFUTURE: Microalgae Protein-Rich Ingredients for the Food And Feed of the Future	Horizon 2020
2023	Product Environmental Profile (PEP) for ABB MCB - Miniature Circuit Breaker (verified)	ABB Stotz-Kontakt GmbH, DE
2023	Product Environmental Profile (PEP) for S2C-HxxL series (verified)	ABB Stotz-Kontakt GmbH, DE
2023	Product Environmental Profile (PEP) for S2C Auxiliary Contacts (verified)	ABB Stotz-Kontakt GmbH, DE
2023	LCA of lens injector systems	Carl Zeiss Meditec AG, DE
2023	Analysis and testing of LCIA methods for biodiversity	Mondi, AT
2023	Critical review, chair: Comparative Life Cycle Assessment of feed additives	Phileo by Lesaffre, FR
2023	Critical review, chair: Comparative Life Cycle Assessment of lubricants	Peter Greven GmbH, DE
2023	Critical review: LCA of a cellulose carbamate fibre	RISE Research Institutes of Sweden AB
2023	Comparative life cycle assessment of sanitary fittings	LIXIL / GROHE AG, DE
2023	Carbon footprint of the City Council of Zurich	City of Zurich
2023	Comparative Life Cycle Assessment of Mondi's paper-based solution to conventional LDPE shrink wrap for bundling and carrying PET bottles (panel critical review)	Mondi, AT
2023	Verification: LCA and EPD of electric bus - B19E01 and K9UD	BYD Company Limited, CN
2023	Comparative LCA of tap water and mineral water in Germany (panel critical review)	wvgw Wirtschafts- und Verlagsgesellschaft Gas und Wasser mbH, DE
2023	Key parameter model for environmental impacts of tap water supply.	wvgw Wirtschafts- und Verlagsgesellschaft Gas und Wasser mbH, DE
2023	Comparative life cycle assessment of resins for fibre compounds	CompPair Technologies Ltd., CH
2023	Screening LCA of different Indian disposal scenarios for mixed plastic waste	Cleanhub GmbH, DE
2023	Critical review: Comparative LCA of packaging kits	Vacheron Constantin, Branch of Richemont International S.A., CH
2023	Critical review, chair: Comparative Life Cycle Assessment: Beef and Veg Burgers	Tesco, UK
2023	Feedback on LCA calculations: Advertising-related emissions and environmental impact in Switzerland	Infras, CH
2023	Critical review, panellist: LCA of liquid fabric enhancers and in-wash fragrance boosters	EarthShiftGlobal, US
2023	Critical review: LCA of plastic foils	Scanfill AB, SE
2023	Comparative carbon footprint of biodegradable polymer compounds (single expert critical review)	Agrana Group, DE
2023	Critical review, panellist: LCA of tofu, A comparison to chicken and beef as protein sources	Long Trail Sustainability, US
2023	Critical review: Carbon footprint of medicine containers	Laboratoire AGUETTANT, FR
2023	PCF assurance: Product Carbon Footprint of kitchen cabinets	Reform Group, DK
2023	Update of the LCIA in naturemade key parameter models: Life cycle assessment for the labelling of electricity, heat, biomethane, biogas and cooling from renewable resources with the naturemade star certification	naturemade - Association for environmentally sound energy (VUE)
2023	Implementation of life cycle inventories of crude oil and natural gas extraction and supply for ecoinvent v3.10	ecoinvent Centre, CH
2023	Implementation of life cycle inventories of crude oil and natural gas extraction and supply for CarbonMinds database	CarbonMinds, DE
2023	Critical review: LCA of polymers	Polykemi Kunshan, CN
2023	Critical review: Carbon footprint of safety shoes	UVEX, DE
2023	Critical review, panellist: Comparative LCA of hygienical products	Mondi, AT

1.2.7 Trainings and public presentation in 2023

Besides the project activities, several trainings, lectures, and presentations have been provided by ESU-services in 2023.

Tab. 1.2 Overview on trainings, presentations and lectures provided by ESU-services in 2023

Speaker	Year	Title	Commissioner	Event
Maresa Bussa	2023	Schulung SimaPro und Ökobilanzen	Austria Juice	Interne Onlineschulung
Niels Jungbluth	2023	Differences between ISO, PEF and EPD applied in watch industry	Federation of the Swiss Watch Industry FH	Internal Workshop
Niels Jungbluth	2023	Environmental impacts of using residues from food processing	Berner Fachhochschule	Pathways of zero net GHG emissic
Niels Jungbluth	2023	Land occupation and land transformation in life cycle inventories	Greenzero.me	Internal Teammeeting
Maresa Bussa, Christoph Meili	2023	Schulung SimaPro und Ökobilanzen	Giesecke-Devrient	Interne Onlineschulung
Christoph Meili	2023	Schulung SimaPro und Ökobilanzen	Enerprice	Interne Onlineschulung
Christoph Meili	2023	Schulung SimaPro und Ökobilanzen	Cabot Switzerland	Interne Schulung
Christoph Meili	2023	Schulung SimaPro und Ökobilanzen	SIOTUU	Interne Onlineschulung
Christoph Meili	2023	Online training in LCA and SimaPro	KION	Internal online training
Maresa Bussa, Christoph Meili	2023	Schulung SimaPro und Ökobilanzen	Vinci construction	Interne Onlineschulung
Niels Jungbluth	2023	Nachhaltige Ernährung in der Schule: Hintergrund und Handlungsmöglichkeiten	Primarschule Oberbüren-Sonnental	Teamsitzung Nachhaltige Ernährung an unserer Schule
Maresa Bussa	2023	Online training in LCA and SimaPro	DeLonghi	Internal online training
Niels Jungbluth	2023	29 years experience in LCI modelling for oil and gas extraction: develop	84th LCA Discussion Forum	LCA development: Did we forget al
Maresa Bussa	2023	Schulung SimaPro und Ökobilanzen	Oxford Economics	Interne Onlineschulung
Christoph Meili	2023	How to reduce encironmental impacts of ICU-mobility	Kantonsspital St. Gallen	Green ICU @ SGI2023
Maresa Bussa	2023	Schulung SimaPro und Ökobilanzen	Fuchs Petrolub	Interne Onlineschulung
Maresa Bussa	2023	Schulung SimaPro und Ökobilanzen	Cartonplast	Interne Onlineschulung
Maresa Bussa	2023	Schulung SimaPro und Ökobilanzen	Dörken	Interne Onlineschulung
Christoph Meili	2023	Schulung SimaPro und Ökobilanzen	CGI	Interne Onlineschulung
Maresa Bussa	2023	Schulung SimaPro und Ökobilanzen	Universität Bayreuth	Interne Schulung
Niels Jungbluth	2023	Ein philosophisches Gespräch über unseren Umgang mit der (Um)Welt	Klima und Umwelt Stadt Baden	Podiumsdiskussion im Thik Theater im Kornhaus, Baden
Christoph Meili	2023	Schulung SimaPro und Ökobilanzen	Swiss Climate	Interne Onlineschulung
Niels Jungbluth	2023	Ökobilanz von Pferden und anderen Haustieren	Bern Expo	BEA Pferd 2023 - Expertenforum
Niels Jungbluth	2023	Life cycle assessment of novel plant products compared to animal pro	Bridge2Food	EcoSystem meeting: Life Cycle As
Maresa Bussa	2023	Life cycle assessment of microalgae enriched food products	Bridge2Food	EcoSystem meeting: Life Cycle As
Niels Jungbluth	2023	Nuklearenergie und Ökobilanz-Bewertungsmethoden	Schweizerische Energie-Stiftung SES, Zürich	Workshop
Maresa Bussa	2023	Online training in LCA and SimaPro	Diehl	Internal training
Maresa Bussa	2023	Schulung SimaPro und Ökobilanzen	Austria Juice	Interne Onlineschulung

2 Environmental product declaration

2.1 Methodology

This implementation of an environmental product declaration is broadly based on the product category rules (PCR) for environmental science and engineering research and development services (PCR 2012). These PCR are based on ISO Standard 14025 for the implementation of environmental declarations (International Organization for Standardization (ISO) 2006a).

The PCR for “research and experimental development services in natural sciences and engineering” has not been updated since 2012 (due to lack of interest). Thus, it is not valid anymore and not available on the environdec webpage.

Deviating from the PCR, the latest versions of the indicators as described in the general programme instructions for the international system (EPD 2021) is used. As described in chapter 4.1 Environmental Footprint Method 3.1 is used for this assessment (Andreasi Bassi et al. 2023).

The life cycle assessment (LCA) method according to ISO 14072 was used to quantify the environmental impacts (International Organization for Standardization (ISO) 2014) for the whole organization. The impacts per consulting hour are recorded according to ISO 14040 (International Organization for Standardization (ISO) 2006b). This method is based on a life-cycle approach, whereby the environmental impacts of a product or organization are recorded and evaluated from the extraction of raw materials through production and use to the disposal phase (from cradle to grave).

No external review or verification of the report has been conducted to date. It is therefore currently an "Environmental Supplier Declaration according to ISO 14021" (International Organization for Standardization (ISO) 2016).

2.2 Goal

This environmental report examines the environmental impacts of the services we offer, considering all relevant aspects as far as possible. The report identifies the main sources of environmental pollution. The purpose of the report is to inform our customers about environmental impacts caused by our services and identify potential areas for improvement. Our first annual environmental report was published in 2014.

2.3 Scope and system description

2.3.1 Functional unit

The functional unit of the EPD refers to 1 hour of consultancy services provided in 2023.

2.3.2 System boundaries

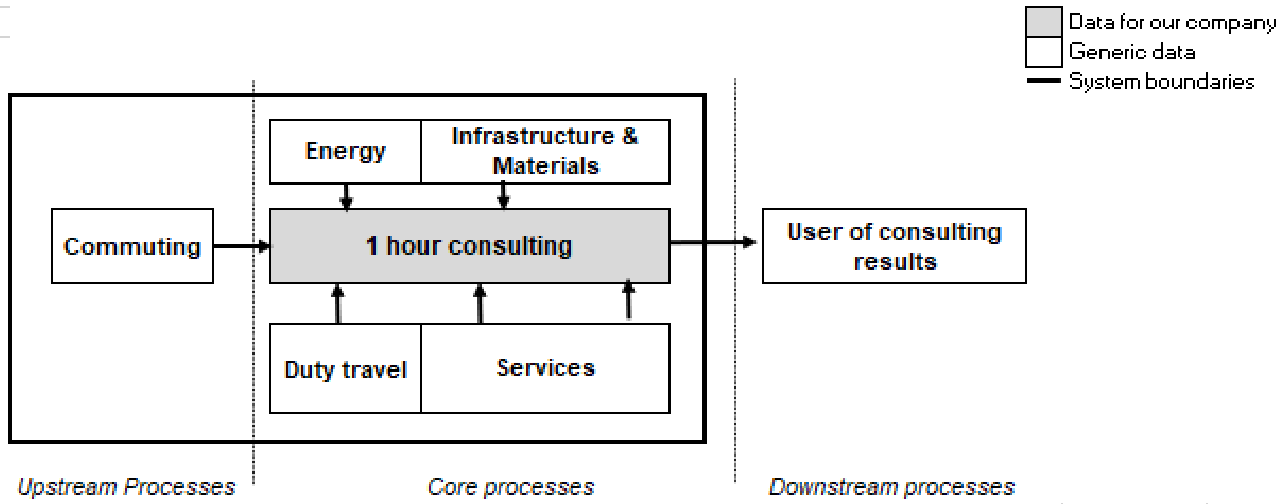
According to the product category rules used (PCR 2012), all environmentally relevant resource consumption and emissions for the investigated system are considered in the LCA as shown in Tab. 2.1. For the impact assessment, the latest implementation of the PEF method in SimaPro was used. A distinction is made between upstream and core processes. The standard "upstream processes" only include individual commuting, as this is not causally related to the service sold. All environmentally relevant processes used for core services are reported under the category "core processes".

In contrast to the requirements of the above-mentioned PCR, this life cycle assessment is prepared without cut-off criteria. This means that all processes are included, even if their contribution to the overall balance sheet is below a certain threshold.

- Upstream process:

    - Individual commuting (not paid by ESU-services)
- Core processes:
    - Energy consumption (electricity and heating)
    - Infrastructure and material consumption (share of buildings, water consumption, paper, IT and electronic equipment, tea, coffee, and monthly team meals)
    - Business trips including hotel accommodation and meals.
    - Purchased services (telecommunications, training, and accounting)
    - Disposal of waste and wastewater

Tab. 2.1 System description for calculating the organizational LCA (PCR 2012)



ESU-services trades with the software SimaPro and third-party databases such as ecoinvent, CarbonMinds database or SHDB (social hotspot database). There are no physical flows involved in this business (e.g., no CDs, etc.) and ESU does not gain ownership on the software and databases, but only distributes the codes to the customers. But, in principle this could also be considered as a purchased service, which is further delivered to our customers. So far there are no data available on the impacts of the software development. Thus, this issue is excluded from the EPD (and also not mentioned in the PCR).

In former version of this report some insurances for employees have been considered in the calculation. This was stopped in 2023 because so far no other examples of LCA for services have been found which include such services purchased by the employer.

2.3.3 Offsetting / compensation of CO_2-emissions

Today many companies use carbon offsetting, compensation, or neutralization as a means of environmental management. They even claim to be carbon neutral.

A carbon offset is a reduction in emissions of carbon dioxide or other greenhouse gases made to compensate for emissions made elsewhere. Offsets are measured in tonnes of carbon dioxide equivalent. One tonne of carbon offset represents the reduction of one tonne of carbon dioxide or its equivalent in other greenhouse gases.

There are service providers and projects on the market that allow offsetting of greenhouse gas emissions related to e.g., travel by air, car, or any other activity. It is tempting to simply pay a small amount of money to offset all the emissions related to one's own activities and claim that the business is carbon neutral.

However, in our point of view this is a misleading approach that lacks purpose. It is also not supported by the underlying standards applied for e.g. an LCA or EPD.

We, as a global community, not only need to reduce greenhouse gas emissions to net zero, but also must immediately capture climate gases that are already in the atmosphere. This is not possible if each company or individual implements simple and cheap solutions or even tries to pass on the responsibility for their own shortcomings to others by purchasing offsets.

To slow down climate change, it is not sufficient to just burn fossil fuels more efficiently, it is necessary to completely stop using and burning them.

Further possible shortcomings of offsetting are:

- The reduction is achieved in the future and not today. So, it does not support the prevention of tipping points in climate change. Furthermore, it might be difficult to ensure that the future capture is really achieved. So, for example, a forest fire can destroy a newly planted tree and then no carbon capture will be achieved. Certificates once sold cannot be taken back if later analysis shows an overestimation of the reductions to be achieved.
- The reduction is a theoretical value assuming that the compensation partner would have done business as usual (e.g., installing a natural gas heating instead of moving alone to an innovative technology like heat pumps or buying a fossil-driven car instead of a Tesla). But, this often does not reflect reality were also other incentives or politics would ask for such a change and the compensation money is just taken as one additional benefit.
- Some compensation schemes promise to protect forest from cutting, but later it has been shown that there were false assumptions regarding the real cutting activities in the areas.
- The storage time of carbon needs to be several thousands of years to avoid overstepping certain climate goals. Carbon capture and removal projects cannot always guarantee such a long-time frame.
- The owner of a heat pump, electric car or PV panel sells the declaration right to a compensation partner, but still profits from the green image of the installations in their premises (or might forget about accounting for the bought CO_2-pollution). Some users of products or services even might not know that emission reduction have already been sold to third parties.
- Rebound effects are not considered. A compensated cruise seems to be fine for the climate and thus more people tend to buy a fully unsustainable holiday package.
- The income from selling climate certificates cannot be spent immediately and compensation measures are initiated much later than the initial emission to be compensated took place. This is another thread for tipping points to be reached without taking immediate action on reducing greenhouse gas emissions.

With the option to offset, we tend to only improve the internal situation where the costs are higher than for the offset, e.g., by opting for a flight and missing the opportunity to travel by train, powered by green electricity. But, with climate compensation, the maximum reduction of total CO_2-emissions is limited to 50% which is not sufficient to reach climate goals.[1]

We think, paying money to other companies or individuals can be done as a voluntary measure, e.g., by supporting so-called Gold Standard projects that also bring social benefits. But, carbon offsets or climate certificates are not suitable as a substitute for one's own actions and should not be claimed in LCA or carbon footprint. And such partners need to be trustworthy which is often difficult to know.

If emissions already occurred, it is helpful if these previous emissions are offset. However, if a decision must be made regarding future emissions: No climate certificate can undo one emitted ton of CO_2, regardless of if you offset it once, twice, or as many times as you want.

1 https://www.esu-services.ch/fileadmin/download/jungbluth-2009-DF37-7.pdf

Many of the critics on carbon compensations are shared by other stakeholders.[2] With these points in mind, ESU-services does not engage directly in carbon compensation measures, but we do our best to reduce our emissions as far as possible and help our customers to do the same.

We also do not factor in compensation in our LCA or carbon footprint studies.

3 Life cycle inventory analysis (LCI)

Available information and own data (such as electricity, heating, and water billing, etc.) were primarily used to model the core processes.

The data for business trips (transport, overnight stays, and meals) was extracted from the expense reports.

The consumption of coffee, tea, and paper was recorded according to receipts and our own estimates. The environmental impacts caused by the manufacture of computers and printers have been broken down to the assumed total service life of a device of 7 years.

ESU uses the naturemade star certified electricity "Naturstrom Schaffhausen" provided for the region by SH power. The electricity mix consists of 80 % hydropower, 15% photovoltaic and 5 % biomass. Losses during electricity transmission are not yet covered by the certificate and are thus modelled as Swiss residual electricity.

Electricity data for the rented office were available for only 5 months (July to November 2023) and are extrapolated for the full year of 2023.

The ESU database was used as background data for transport and materials (ESU-services 2024a). Data for the production of coffee, tea, meals, and provision of overnight stays are taken from the company's own database (ESU-services 2024b). For purchased services, expenditure data is linked to data from the Swiss environmental-extended input-output table to calculate environmental impacts (Jungbluth et al. 2011). The modelling and evaluation were carried out in the LCA software SimaPro 2024.

The complete life cycle inventory for the environmental report is shown in Tab. 3.1.

2 See e.g. https://www.worldwildlife.org/publications/wwf-position-and-guidance-on-voluntary-purchases-of-carbon-credits, https://www.weforum.org/agenda/2021/09/greenpeace-international-carbon-offsetting-net-zero-pledges-climate-change-action/, https://climatenetwork.org/wp-content/uploads/2022/11/CAN-Positon_Carbon-offsetting_Nov-2022.pdf

Tab. 3.1 Unit process raw data per year of consulting services provided by ESU-services Ltd. in 2023

	Name	Location	Infrastructur	Unit	environmental report, 2023	UncertaintyType	StandardDeviation95%	GeneralComment
	Location				ESU			
	InfrastructureProcess				0			
	Unit				a			
	environmental report, 2023	ESU	0	a	1			
Heat	natural gas, burned in boiler modulating >100kW	RER	0	MJ	9.96E+3	1	1.05	(1,1,1,1,1,1,BU:1.05); company data; from utility balance
Electricity	electricity, low voltage, at grid	CH	0	kWh	0	1	1.31	(2,3,1,1,3,5,BU:1.05); general electricity (staircase lighting); Kurt Peyer Nebenkosten
	electricity, low voltage, parameterized, at grid	KWM	0	kWh	7.03E+2	1	1.31	(2,3,1,1,3,5,BU:1.05); electricity use in the office, 80% Hydropower, 15% PV and 5% Biomass: SH Power Rechnungen
	electricity, low voltage, certified electricity, at grid	CH	0	kWh	8.25E-1	1	1.12	(3,3,1,1,1,1,BU:1.05); Electricity consumption of internet server provider; Metanet.ch
	Heat, waste	-	-	MJ	2.53E+3	1	1.31	(2,3,1,1,3,5,BU:1.05); calculated from electricity uses; own assumption
Building	building, multi-storey	RER	1	m3	4.38E-1	1	3.00	(1,2,1,1,1,1,BU:3); 80 years life time, room height incl. Floor area about 3m; own calculation
Paper	paper, recycling, no deinking, at plant	RER	0	kg	2.40E+0	1	1.30	(4,1,1,1,1,5,BU:1.05); Use of recycling paper for printers; Balance sheet
	paper, recycling, no deinking, at plant	RER	0	kg	6.99E+1	1	1.30	(4,1,1,1,1,5,BU:1.05); Use of toilet paper, recycling quality; own calculation assuming annual usage of 21kg of toilet paper per pax
Beverages and Mmeals	ground coffee, in PET/EVOH/PE-bag, at household	RER	0	kg	7.88E-1	1	1.30	(4,1,1,1,1,5,BU:1.05); 1 person à 40%; 1 person à 80%; own calculation
	black tea, Darjeeling, conventional, at regional storage	DE	0	kg	1.56E+0	1	1.30	(4,1,1,1,1,5,BU:1.05); 1 pax à 80%; own calculation
	menu, 3 courses, vegetarian, at kitchen	CH	0	unit	3.00E+1	1	1.30	(4,1,1,1,1,5,BU:1.05); Annahme: 50% vegi; own calculation
	menu, 3 courses, with meat, event restaurant, at kitchen	CH	0	unit	3.00E+1	1	1.30	(4,1,1,1,1,5,BU:1.05); Annahme: 50% mit Fleisch; own calculation
Waste	disposal, municipal solid waste, 22.9% water, to municipal incineration	CH	0	kg	1.60E+1	1	1.30	(4,1,1,1,1,5,BU:1.05); Estimation, 5 kg per week; own assumption
Water	tap water, unspecified natural origin CH, at user	CH	0	kg	2.05E+4	1	1.21	(4,1,1,1,1,1,BU:1.05); company data; property management
	treatment, sewage, to wastewater treatment, class 3	CH	0	m3	2.05E+1	1	1.21	(4,1,1,1,1,1,BU:1.05); calculated with water balance; own assumption
Computer	desktop computer, without screen, at plant	GLO	0	unit	8.33E-2	1	1.05	(1,1,1,1,1,1,BU:1.05); 3 PC, Average life time 11 years; own assumption
	laptop computer, at plant	GLO	0	unit	7.14E-1	1	1.05	(1,1,1,1,1,1,BU:1.05); 5, Average life time 7 years; own assumption
	LCD flat screen, 17 inches, at plant	GLO	0	unit	5.00E-1	1	1.05	(1,1,1,1,1,1,BU:1.05); 4, Average life time 10 years; own assumption
	printer, laser jet, b/w, at plant	GLO	0	unit	1.00E-1	1	1.05	(1,1,1,1,1,1,BU:1.05); 1, Average life time 10 years; own assumption
	toner module, laser jet, b/w, at plant	GLO	0	unit	1.00E+0	1	1.05	(1,1,1,1,1,1,BU:1.05); units used; expense accounts
Transports	transport, average train, SBB mix	CH	0	pkm	2.24E+4	1	2.00	(1,1,1,1,1,1,BU:2); Commuting; expense accounts
	transport, passenger car, fleet average	CH	0	pkm	0	1	2.00	(1,1,1,1,1,1,BU:2); Buisness trips; expense accounts
	transport, freight, light commercial vehicle	CH	0	tkm	8.11E+0	1	2.00	(1,1,1,1,1,1,BU:2); Buisness trips; expense accounts
	transport, aircraft, passenger, Europe	RER	0	pkm	0	1	2.00	(1,1,1,1,1,1,BU:2); Business trips; expense accounts
	transport, aircraft, passenger, intercontinental	RER	0	pkm	0	1	2.00	(1,1,1,1,1,1,BU:2); Business trips; expense accounts
	transport, average train, SBB mix	CH	0	pkm	0	1	2.00	(1,1,1,1,1,1,BU:2); Business trips by Swiss rail; expense accounts
	transport, average train	DE	0	pkm	2.05E+3	1	2.00	(1,1,1,1,1,1,BU:2); Business trips; expense accounts
	transport, average train	IT	0	pkm	0	1	2.00	(1,1,1,1,1,1,BU:2); Business trips; expense accounts
	transport, average train	BE	0	pkm	1.30E+3	1	2.00	(1,1,1,1,1,1,BU:2); Business trips; expense accounts
	transport, average train	FR	0	pkm	2.25E+3	1	2.00	(1,1,1,1,1,1,BU:2); Business trips; expense accounts
	transport, average train	AT	0	pkm	0	1	2.00	(1,1,1,1,1,1,BU:2); Business trips; expense accounts
	transport, passenger coach, InterCity-Bus	CH	0	pkm	1.10E+3	1	2.00	(1,1,1,1,1,1,BU:2); Business trips; expense accounts
	transport, ferry boat	CH	0	tkm	7.68E+1	1	1.05	(1,1,1,1,1,1,BU:1.05); Business trips, 60 kg is assumed as body weight; expense accounts
Hotel	guest-night, average European hotel	RER	0	unit	4.50E+0	1	1.05	(1,1,1,1,1,1,BU:1.05); Business trips; expense accounts
	breakfast, simple restaurant, at kitchen	CH	0	unit	4.50E+0	1	1.05	(1,1,1,1,1,1,BU:1.05); Business trips; expense accounts
	menu, 3 courses, vegetarian, at kitchen	CH	0	unit	4.50E+0	1	1.05	(1,1,1,1,1,1,BU:1.05); Business trips; expense accounts
	menu, 3 courses, with meat, event restaurant, at kitchen	CH	0	unit	4.50E+0	1	1.05	(1,1,1,1,1,1,BU:1.05); Business trips; expense accounts
Financial services	G66, insurance and pension funding	CH	0	CHF2005	0	1	1.05	(1,1,1,1,1,1,BU:1.05); Social insurance, share of company, Balance sheet
	G80, education	CH	0	CHF2005	3.04E+3	1	1.05	(1,1,1,1,1,1,BU:1.05); Training; Balance sheet
	G71u74, other business activities	CH	0	CHF2005	3.40E+3	1	1.05	(1,1,1,1,1,1,BU:1.05); Accounting; Balance sheet
	G64, post and telecommunications	CH	0	CHF2005	1.16E+3	1	1.05	(1,1,1,1,1,1,BU:1.05); Telecommunication services; Balance sheet

4 Life cycle impact assessment

In this chapter the environmental impacts are presented according to the different environmental indicators.

4.1 European environmental footprint method (EF 3.1, 2023)

The Environmental Footprint (EF) method is developed and recommended by the EF Initiative of the European Commission for assessing the environmental impacts of products and organisations. It has thus already been developed for future use in consumer information. This method and its impact categories are also used for B2B communication in the context of environmental declarations in Europe (European Committee for Standardisation (CEN) 2022). The implementation in SimaPro is based on EF method 3.1. It includes normalization and weighting.

In the European context EF3.1 is often considered as state of the art because it has been updated recently, includes latest IPCC 2021 characterisation factors and is the method of choice for PEF and EPD studies. EF 3.1 is a political consensus. EF is not so much used in the US.

4.1.1 Characterisation

The characterization methods are described in one document (Andreasi Bassi et al. 2023). A description of the impact categories considered can be found in Tab. 4.1.

Tab. 4.1 Midpoint impact categories used in this study (Andreasi Bassi et al. 2023)

Impact category	Impact assessment model	Indicator unit	Source
Climate change	The Global Warming Potential (GWP) calculates the radiative forcing over a 100 year time horizon. It assesses the potential impact of different gaseous emissions on climate change.	kg CO_2 eq	IPCC 2021 + JRC adaptions
Ozone depletion	The Ozone Depletion Potential (ODP) calculates the destructive effects on the stratospheric ozone layer over a time horizon of 100 years. The stratospheric ozone layer reduces the amount of UV-radiation that reaches the ground, and which can cause damages for humans, animals, plants and materials.	kg CFC-11 eq	EDIP model based on the ODPs of WMO 2014 + integrations from other sources
Ionizing radiation	This category estimates the effect of radioactive emissions on human health. Most radiation stems from normal operation of nuclear power plants including the nuclear fuel production and treatment of radioactive wastes (accidents are not included). Quantification of the impact of ionizing radiation on the population is made with reference to Uranium 235.	kg U^{235} eq	Frischknecht et al. 2000
Photochemical ozone formation	This category calculates the effect of summer smog on human health. Ozone and other reactive oxygen compounds are formed as secondary contaminants in the troposphere (close to the ground). Ozone is formed by the oxidation of the primary contaminants VOC (Volatile Organic Compounds) or CO (carbon monoxide) in the presence of NOx (nitrogen oxides) under the influence of light. Expression of the potential contribution to photochemical ozone formation close to the ground. The method used includes spatial differentiation and is only valid for Europe. Considering a marginal increase in ozone formation, the LOTOS-EUROS spatially differentiated model averages over 14000 grid cells to define European factors.	kg NMVOC eq	Van Zelm et al. 2008 as applied in ReCiPe
Human toxicity, non-cancer	The unit “CTUh” (Comparative Toxic Unit for Humans) expresses the estimated increase in morbidity in the total human population due to different types of emissions entering into the environment. The calculation is based on USEtox® 2.1, which is a model that describes chemical fate, exposure, effect and optionally severity of emissions. No spatial differentiation beyond continent and world compartments. Specific groups of chemicals require further works (cf. details in other sections). Impact indicator: Comparative Toxic Unit for human (CTUh) expressing the estimated increase in morbidity in the total human population per unit mass of a chemical emitted (cases per kilogram).	CTUh	Fantke et al. 2017 Rosenbaum et al. 2008 as in Saouter et al. 2018
Human toxicity, cancer	Based on USEtox 2.1 model, see above	CTUh	Fantke et al. 2017 Rosenbaum et al. 2008 as in Saouter et al. 2018
Acidification	This impact category describes potential impacts on soil and freshwater that becomes more acid due to the deposition of certain pollutants from air: The “Accumulated Exceedance” model characterizes the change in critical load exceedance of the sensitive area in terrestrial and main freshwater ecosystems, to which acidifying substances deposit.	molc H+ eq	Posch et al. 2008 Seppälä et al. 2006
Particulate matter	This category estimates the potential effect of fine dust emissions on human health: The indicator is calculated applying the average slope between the Emission Response Function (ERF) working point and the theoretical minimum-risk level. Exposure model based on archetypes that include urban environments, rural environments, and indoor environments within urban and rural areas.	Disease incidence	Fantke et al. 2016

Impact category	Impact assessment model	Indicator unit	Source
Eutrophication, freshwater	Expression of the degree to which the nutrients emitted in Europe reach the freshwater and lead to the problem of eutrophication. Only phosphorus emissions are evaluated since it is considered as the limiting factor in freshwater. EUTREND model used to model atmospheric emissions. Impact indicator: Phosphorus equivalents: European validity. Averaged characterization factors from country dependent characterization factors.	kg P eq	Struijs et al. 2009 as implemented in ReCiPe
Eutrophication, marine	Expression of the degree to which nutrients emitted in Europe reach the oceans and lead to eutrophication. Only nitrogen emissions evaluated since it is considered as the limiting factor in marine water. EUTREND model used to model atmospheric emissions. Impact indicator: Nitrogen equivalents.	kg N eq	Struijs et al. 2009 as implemented in ReCiPe
Eutrophication, terrestrial	Eutrophication means that too many nutrients reach ecosystems and harm the plants and animals living in sensitive systems: The “Accumulated Exceedance” model characterizes the change in critical load exceedance of the sensitive terrestrial area, to which eutrophying substances (“excess nutrients”) deposit. It is European-country dependent which is not considered with the LCI data used in this study.	molc N eq	Posch et al. 2008 Seppälä et al. 2006
Ecotoxicity, freshwater	Measurement of environmental toxicity in freshwater due to emissions: The unit “CTUe” (Comparative Toxic Unit for ecosystems) is an expression of an estimate of the potentially affected fraction of species (PAF) integrated over time and volume per unit mass of a chemical emitted (PAF m3 year/kg). Specific groups of chemicals require further works. USEtox consensus model (multimedia model). No spatial differentiation beyond continent and world compartments. Specific groups of chemicals requires further works.	CTUe	Fantke et al. 2017 Rosenbaum et al. 2008 as in Saouter et al. 2018
Land use	Land use refers here to the amount and quality deficit of land occupied or transformed. This model is based on soil quality index as in LANCA model. CFs set was re-Calculated by JRC starting from LANCA® v 2.5 as baseline model. Out of 5 original indicators (Erosion resistance, Mechanical filtration, Physicochemical filtration, Groundwater regeneration, Biotic production) only 4 have been included in the aggregation (Physicochemical filtration was excluded due to the high correlation with the mechanical filtration). Biodiversity impacts are not covered in this method.[3]	Pt	De Laurentiis et al. 2019; Horn et al. 2018
Water use	Assessment of the water use related to local scarcity of water in different countries. Relative Available WAter REmaining (AWARE) per area in a watershed, after the demand of humans and aquatic ecosystems has been met.	m³ deprived	Boulay et al. 2018
Resource use, fossils	Abiotic resource depletion fossil fuels (ADP-fossil); based on lower heating value	MJ eq	van Oers et al. 2002
Resource use, minerals and metals	Ultimate reserves model. The model takes both the annual production as well as the availability of the resource into account. (CML 2002 model). ADP for energy carriers, based on van Oers et al. 2002 as implemented in CML, v. 4.8 (2016). Depletion model based on use-to-availability ratio. Full substitution among fossil energy carriers is assumed.	kg Sb eq	van Oers et al. 2002

3 The LCIA method in SimaPro has assigned characterisation factors for elementary flows of land use in the ocean „benthos“. These factors have been removed after consulting the authors of the method as they are not meaningful.

4.1.2 Long-term emissions

Some indicators are strongly dependent on long-term emissions. Such long-term emissions can only be modelled in a quite unreliable way. Some databases such as ecoinvent investigate long-term emissions of heavy metals and other pollutants (Frischknecht et al. 2007a). These emissions can take place in a time frame of 100 to 60’000 years from now. They mainly stem from waste disposal in landfills and deposits made during mining of metals.

If these long-term-emissions are included in the LCIA they can make up a considerable amount of the total impacts in the ILCD impact categories. The analysis of e.g. heating options shows that in five categories, a considerable part of total impacts solely stems from the long-term emissions if they are included in the LCI:

- Human toxicity, non-cancer effects: 50 to 80%
- Human toxicity, cancer effects: 4 to 80%
- Ionizing radiation HH: around 70% for all datasets
- Freshwater eutrophication: 30 to 90%
- Freshwater ecotoxicity: 40 to almost 100%

If long-term emissions are included in the assessment, background data on e.g. machinery become very relevant, but it is nearly impossible to check the appropriateness of this data.

An extensive discussion about the pros and cons of including long-term emissions in LCIA can be found in the Ecoinvent report on LCIA methods (Frischknecht et al. 2007b).

In the authors' view, other aspects also speak against assigning a high weight to long-term emissions in the LCA assessment (cf. the detailed discussion in Frischknecht et al. 2007b). ESU-services recommends excluding long-term emissions in the life cycle impact assessment because of the high uncertainties involved.

4.1.3 Adjustments for water use

For the impact category water use, the available, country-specific scarcity factors are used. The determination and application of region-specific factors for water extraction would make the study and interpretation considerably more complex. However, the observation can be helpful in estimating the influence of unnecessarily extracted water. The difference between water withdrawal and return is relevant for the evaluation (and thus the removal of water from a region). This is often only roughly estimated in the data used and this indicator is thus considered relatively uncertain.

For use with the ESU database (ESU-services 2024a, b), some special features are considered. The AWARE factors in SimaPro (for the ecoinvent v3 database) also evaluate the water quantity for water turbines and cooling. However, the databases based on ecoinvent v2 do not include the corresponding return flows into the catchment area. Therefore, these contributions are ignored.

4.1.4 Normalization and Weighting

The normalization and weighting factors are shown in Tab. 4.2

- Normalization (Crenna et al. 2019).
- Weighing factors (Sala et al. 2018)

Tab. 4.2 Normalization and weighting factors applied for the EF method in SimaPro

Impact category	Normalization	Weighting
Climate change	0,0001324	21,1%
Ozone depletion	19,10	6,3%
Ionising radiation	0,000237	5,0%
Photochemical ozone formation	0,02447	4,8%
Particulate matter	1680	9,0%
Human toxicity, non-cancer	7768	1,8%
Human toxicity, cancer	57961	2,1%
Acidification	0,018	6,2%
Eutrophication, freshwater	0,6223	2,8%
Eutrophication, marine	0,05116	3,0%
Eutrophication, terrestrial	0,005658	3,7%
Ecotoxicity, freshwater	0,00001763	1,9%
Land use	0,00000122	7,9%
Water use	0,00008719	8,5%
Resource use, fossils	0,00001538	8,3%
Resource use, minerals and metals	15,72	7,6%

4.1.5 Reliability of impact categories indicator results

One issue that arises when using methods such as the EF method is the interpretation of possible trade-offs between different impact categories. In several cases in this study, different processing alternatives were determined to be more favourable depending on the indicators. One solution to this is normalisation and weighting, which determines which indicators are considered more or less important and summarises all environmental impacts in one dimensionless indicator (single score).

Normalisation refers to calculating the magnitude of category indicator results relative to reference information. In many cases, total emissions and the resource use of one person over the course of a year in a certain area e.g. Switzerland, Europe, or worldwide are used as a reference. Weighting refers to converting and possibly aggregating indicator results across impact categories using numerical factors based on value-choices. The weighting factors applied express the relative importance of different environmental indicators for decision making. This can be based on the environmental relevance, but also on other aspects such as reliability of the indicator. Single scores are calculated by adding the results of all category indicators multiplied by the normalisation factor and the weighting factor for each category (International Organization for Standardization (ISO) 2006c). The world population was used to calculate the normalisation factors and the weighting system developed by Sala et al. 2018 was applied in the Environmental Footprint method.

Climate change is often in the forefront of public debate on environmental issues and during the development of the weighting approach for the EF method, surveys of the general population and LCA experts revealed that climate change was one of the top three concerns in all three categories considered (human health, natural environmental, and natural resources) for both survey groups (Sala et al. 2018). The IPCC models show that global warming is likely to happen to an extent that can be considered dangerous, and the scenarios of 2013 show more global warming compared to the scenarios from 2007, indicating that the problem is intensifying. Therefore, this problem is generally considered important for the interpretation of LCA results.

The assessment of the impact on ozone depletion is based on sound modelling. However, much of the impact stems from background data. The emissions of ozone depleting substances were reduced considerably in the past years since the Montreal protocol regulates the phasing out of the use of these substances. Which means the age of data sources often determines the ozone depletion result (and not the real impact). Therefore, the results in this impact category do not provide much informative value and this indicator should not be given priority when comparing the environmental impacts.

The category ionising radiation reflects the use of nuclear power. Since market mixes were used, the share of nuclear power is reflected in the impacts in this category. This category is therefore important if different energy-generation systems are being compared, for example the comparison of cultivation approaches partly powered by photovoltaics vs. conventional electricity.

According to the previously-mentioned survey of LCA experts, particulate matter was considered to be the second most worrisome category in terms of human health, after only human toxicity, cancer (Sala et al. 2018). The EF method characterises the emissions in terms of disease incidence due to the emission of particulate matter according to the model developed by Fantke et al. 2016. The representation of relevant substances in the background data is good and modelling generates reliable results.

Nitrogen oxides play a key role in the impact categories photochemical ozone formation, acidification, and marine and terrestrial eutrophication. As a result, there is a certain degree of correlation between these impact categories and the overlap should be considered in the interpretation. Freshwater eutrophication on the other hand is dominated by phosphorous emissions.

In terms of human health, both experts and members of the general public consider human toxicity, cancer to be the most worrisome impact category and the general public rated both types of human toxicity as relevant (Sala et al. 2018). While these impact categories are deemed important, they are, along with freshwater ecotoxicity, among the least robust indicators included in the method (Sala et al. 2018: Table 30).

Land use and water use were considered relevant in the survey of LCA experts (Sala et al. 2018), and land use in particular is an important factor to be considered when comparing biogenic products. Although both methods have been updated since the ILCD, these impact categories are not considered highly robust (Sala et al. 2018: Table 30).

Resource use, fossils is driven using fossil fuels and feedstocks and thus often shows a similar tendency as the climate change indicator. The category resource, minerals and metals is often dominated by one single substance, with a characterisation factor, which should be taken into account when considering this impact category.

4.1.6 Reference values and examples

Tab. 4.3 shows typical reference values for this impact assessment method.

Tab. 4.3 Reference values for products and services causing one thousandth EF points

EF3.1	One milli-eco-point equals ...
24.206,7	litres of tapwater from Switzerland
0,9	centimeters road, used for one year
35,9	kilograms of fossil CO2, directly emitted
1,2	kilograms of fossil methane, directly emitted
11,13	grams copper input into agricultural soil
10,8	litres crude oil produced, with transport to the refinery
0,20	grams pesticide application in agriculture
25%	of a person's private daily consumption in Switzerland, 2018
24%	the daily consumption of a person in Switzerland
100,7	km transport of one person by plane
62,5	km transport of one person by car (occupancy 1.6 persons)
1.536,3	km transport of one person by bicycle
102%	of a vegetarian menu with 4 courses
63%	of a meaty 3-course menu
136%	of the daily food consumption of a person in Switzerland, 2018
2,1	plastic carrier bags (production, distribution and disposal)
0,18	cotton T-Shirts
1,2%	of the production of a laptop
335%	of daily consumption for hobbies/leisure activities in Switzerland, 2018
595%	of daily consumption of furniture and household appliances in Switzerland, 20

4.2 Category indicators according to environmental footprint method

Tab. 4.4 shows the environmental impacts of upstream and core processes according to the environmental indicators in the environmental footprint method. Results are presented for the 16 different environmental indicators according to EU-JRC recommendation (Andreasi Bassi et al. 2023). The share of the processes on every environmental indicator is highlighted by a coloured scale, in which the highest value is purple and the lowest is light blue.

The process infrastructure and materials have the highest share on the total impact of all indicators, whereas the most relevant factors are nutrition (primarily lunches), but also to a smaller degree devices such as computers and printers. Lunches are the individual choices of the employees. As a sustainability-based company vegetarian/vegan choices are the primary choices of our employees. Conservatively it was assumed that 50% of the lunches are meat-based. Also the computers used are primarily used as long as possible. The assumption of a lifetime of 7 years for laptops, 10 years for LCD screens and printers and 11 years for a desktop PC might be underestimated. An exceptional process contributing to this category is the moving truck transportation.

Even though the total number of person kilometres travelled for commuting is higher than for business trips, the process business trips is responsible for a higher share of the total impact of the indicators. This is not only due to hotel stays and meals (which are included in business trips), but also due to the country-specific electricity mixes used for train travel abroad, which often have a higher environmental impact than the Swiss electricity mix used for commuting by train in Switzerland. Also of influence is the mode of transportation as an intercity-coach and the ferry was used.

As the only upstream process, commuting contributes relatively little to the impact for all indicators. Furthermore, commuting is in the responsibility of the staff and not paid by ESU-services. With the possibility of home office, it became less relevant than prior to the Corona crisis.

Because of a change to more home office and teleconferencing, both commuting and business trips have decreased significantly in the last few years during the corona crisis. In 2022 and 2023, these two processes have increased again, however, not yet reaching the pre-pandemic levels.

The process with the lowest contribution to the overall impact for all indicators is disposal. Since consultation is a service and uses only small quantities of material goods (compared to production), the disposal of materials is responsible for only a small share to the overall impacts.

In some categories also the category services, which includes external accounting services, training and telecommunication. As telecommunication is the least relevant factor, this category is dominated by training and accounting.

Also, energy is in some categories a relevant factor, whereas heating is slightly more important than the electricity usage. The naturemade star certified electricity "Naturstrom Schaffhausen" is used, provided by SH Power. Heating is provided by natural gas and will be switched to renewable district heat in 2024.

Social insurances were a part of previous assessments of ESU. They are not calculated for this year as they are a dominating factor, and the data comes with many insecurities as most of the social security facilities do not disclose their activities and the payments are legally necessary. Also, social insurances are rarely included in LCAs.

It should be noted that environmental product declarations and reports from different programmes or initiatives cannot be compared with each other or cannot be compared.

Tab. 4.4 Life cycle impact assessment per hour of ESU-services consulting in 2023 according to different environmental indicators

Indicator	Unit	*UPSTREAM*	*CORE PROCESSES*					TOTAL	TOTAL without travel
		Commuting	Energy	Infrastruct. & Materials	Business trips	Services	Disposal		
Climate change	kg CO2 eq	2.3E-02	1.2E-01	1.6E-01	6.3E-02	1.2E-01	2.2E-03	4.9E-01	4.2E-01
Share	%	*5%*	*24%*	*33%*	*13%*	*25%*	*0%*	*100%*	*87%*
Ozone depletion	kg CFC11 eq	2.0E-09	1.5E-08	9.5E-09	3.9E-09	2.1E-07	7.4E-11	2.4E-07	2.3E-07
Share	%	*1%*	*6%*	*4%*	*2%*	*87%*	*0%*	*100%*	*98%*
Ionising radiation	kBq U-235 eq	3.4E-02	7.6E-02	1.1E-01	6.4E-02	5.1E-02	5.2E-04	3.3E-01	2.7E-01
Share	%	*10%*	*23%*	*32%*	*19%*	*15%*	*0%*	*100%*	*81%*
Photochemical ozone format	kg NMVOC eq	7.3E-05	1.6E-04	4.9E-04	2.8E-04	4.4E-04	5.1E-06	1.5E-03	1.2E-03
Share	%	*5%*	*11%*	*34%*	*19%*	*30%*	*0%*	*100%*	*81%*
Particulate matter	disease inc.	1.3E-09	8.5E-10	6.9E-09	2.6E-09	7.7E-09	9.3E-11	1.9E-08	1.7E-08
Share	%	*7%*	*4%*	*36%*	*14%*	*39%*	*0%*	*100%*	*86%*
Human toxicity, non-cancer	CTUh	4.6E-10	3.0E-10	6.6E-09	6.2E-10	2.1E-09	1.9E-10	1.0E-08	9.6E-09
Share	%	*4%*	*3%*	*65%*	*6%*	*20%*	*2%*	*100%*	*94%*
Human toxicity, cancer	CTUh	3.6E-11	1.3E-11	1.0E-10	3.2E-11	9.9E-11	5.3E-12	2.9E-10	2.6E-10
Share	%	*12%*	*4%*	*36%*	*11%*	*34%*	*2%*	*100%*	*89%*
Acidification	mol H+ eq	8.6E-05	1.1E-04	8.6E-04	3.1E-04	6.1E-04	1.1E-05	2.0E-03	1.7E-03
Share	%	*4%*	*6%*	*43%*	*16%*	*31%*	*1%*	*100%*	*84%*
Eutrophication, freshwater	kg P eq	1.1E-05	2.5E-05	1.4E-04	2.1E-05	5.7E-05	3.0E-06	2.6E-04	2.4E-04
Share	%	*4%*	*10%*	*55%*	*8%*	*22%*	*1%*	*100%*	*92%*
Eutrophication, marine	kg N eq	1.9E-05	3.4E-05	2.8E-04	1.0E-04	1.3E-04	5.6E-05	6.2E-04	5.2E-04
Share	%	*3%*	*6%*	*45%*	*16%*	*20%*	*9%*	*100%*	*84%*
Eutrophication, terrestrial	mol N eq	1.9E-04	3.3E-04	2.4E-03	1.1E-03	1.4E-03	3.3E-05	5.4E-03	4.3E-03
Share	%	*4%*	*6%*	*44%*	*20%*	*25%*	*1%*	*100%*	*80%*
Ecotoxicity, freshwater	CTUe	7.7E-02	8.9E-02	1.1E+00	3.1E-01	5.6E-01	1.6E-01	2.3E+00	2.0E+00
Share	%	*3%*	*4%*	*48%*	*13%*	*24%*	*7%*	*100%*	*87%*
Land use	Pt	8.5E-01	1.0E-01	2.1E+00	5.7E-01	1.5E+00	6.0E-03	5.2E+00	4.6E+00
Share	%	*16%*	*2%*	*41%*	*11%*	*30%*	*0%*	*100%*	*89%*
Water use	m3 depriv.	2.2E-02	2.2E-02	9.7E-02	3.8E-02	1.4E-01	1.0E-03	3.2E-01	2.8E-01
Share	%	*7%*	*7%*	*30%*	*12%*	*44%*	*0%*	*100%*	*88%*
Resource use, fossils	MJ	5.1E-01	2.3E+00	2.7E+00	1.3E+00	2.4E+00	1.3E-02	9.2E+00	7.8E+00
Share	%	*6%*	*25%*	*29%*	*15%*	*26%*	*0%*	*100%*	*85%*
Resource use, minerals and	kg Sb eq	1.7E-07	1.6E-07	1.0E-05	1.1E-07	9.5E-06	5.2E-09	2.0E-05	2.0E-05
Share	%	*1%*	*1%*	*51%*	*1%*	*47%*	*0%*	*100%*	*99%*
Climate change - Fossil	kg CO2 eq	2.3E-02	1.1E-01	1.6E-01	6.2E-02	1.2E-01	2.2E-03	4.8E-01	4.1E-01
Share	%	*5%*	*24%*	*33%*	*13%*	*25%*	*0%*	*100%*	*87%*
Climate change - Biogenic	kg CO2 eq	1.1E-04	1.2E-03	5.3E-03	1.1E-03	1.1E-03	3.9E-05	8.9E-03	7.8E-03
Share	%	*1%*	*14%*	*60%*	*13%*	*12%*	*0%*	*100%*	*87%*
Climate change - Land use a	kg CO2 eq	1.8E-04	4.7E-05	1.9E-03	3.0E-04	1.9E-04	5.2E-07	2.6E-03	2.3E-03
Share	%	*7%*	*2%*	*72%*	*12%*	*7%*	*0%*	*100%*	*88%*
Human toxicity, non-cancer -	CTUh	2.2E-11	3.0E-11	3.1E-09	1.0E-10	9.7E-11	5.7E-13	3.4E-09	3.2E-09
Share	%	*1%*	*1%*	*93%*	*3%*	*3%*	*0%*	*100%*	*97%*
Human toxicity, non-cancer -	CTUh	4.4E-10	2.7E-10	3.5E-09	5.1E-10	2.0E-09	1.9E-10	6.9E-09	6.4E-09
Share	%	*6%*	*4%*	*51%*	*7%*	*29%*	*3%*	*100%*	*93%*
Human toxicity, cancer - orga	CTUh	4.8E-12	4.8E-12	2.3E-11	1.4E-11	2.0E-11	1.4E-13	6.6E-11	5.2E-11
Share	%	*7%*	*7%*	*34%*	*21%*	*30%*	*0%*	*100%*	*79%*
Human toxicity, cancer - inorg	CTUh	3.1E-11	7.9E-12	8.1E-11	1.9E-11	7.9E-11	5.2E-12	2.2E-10	2.0E-10
Share	%	*14%*	*4%*	*36%*	*8%*	*35%*	*2%*	*100%*	*92%*
Ecotoxicity, freshwater - orga	CTUe	3.0E-03	1.4E-03	4.4E-01	6.9E-02	1.4E-01	6.6E-05	6.6E-01	5.9E-01
Share	%	*0%*	*0%*	*67%*	*11%*	*22%*	*0%*	*100%*	*89%*
Ecotoxicity, freshwater - inorg	CTUe	7.4E-02	8.8E-02	6.7E-01	2.4E-01	4.1E-01	1.6E-01	1.6E+00	1.4E+00
Share	%	*4%*	*5%*	*41%*	*14%*	*25%*	*10%*	*100%*	*86%*
Single-score Points	Pt	2.9E-06	8.5E-06	1.3E-05	9.8E-06	1.5E-05	3.0E-06	7.2E-05	6.3E-05
Share	%	*4%*	*12%*	*17%*	*14%*	*21%*	*4%*	*100%*	*86%*

4.3 Carbon footprint

An analysis for the global warming potential can be found in Fig. 4.1. As with the environmental footprint method, the infrastructure and materials category are the major impact in the core balance. Externally purchased services for accounting, training and telecommunication are relevant as well as the energy used.

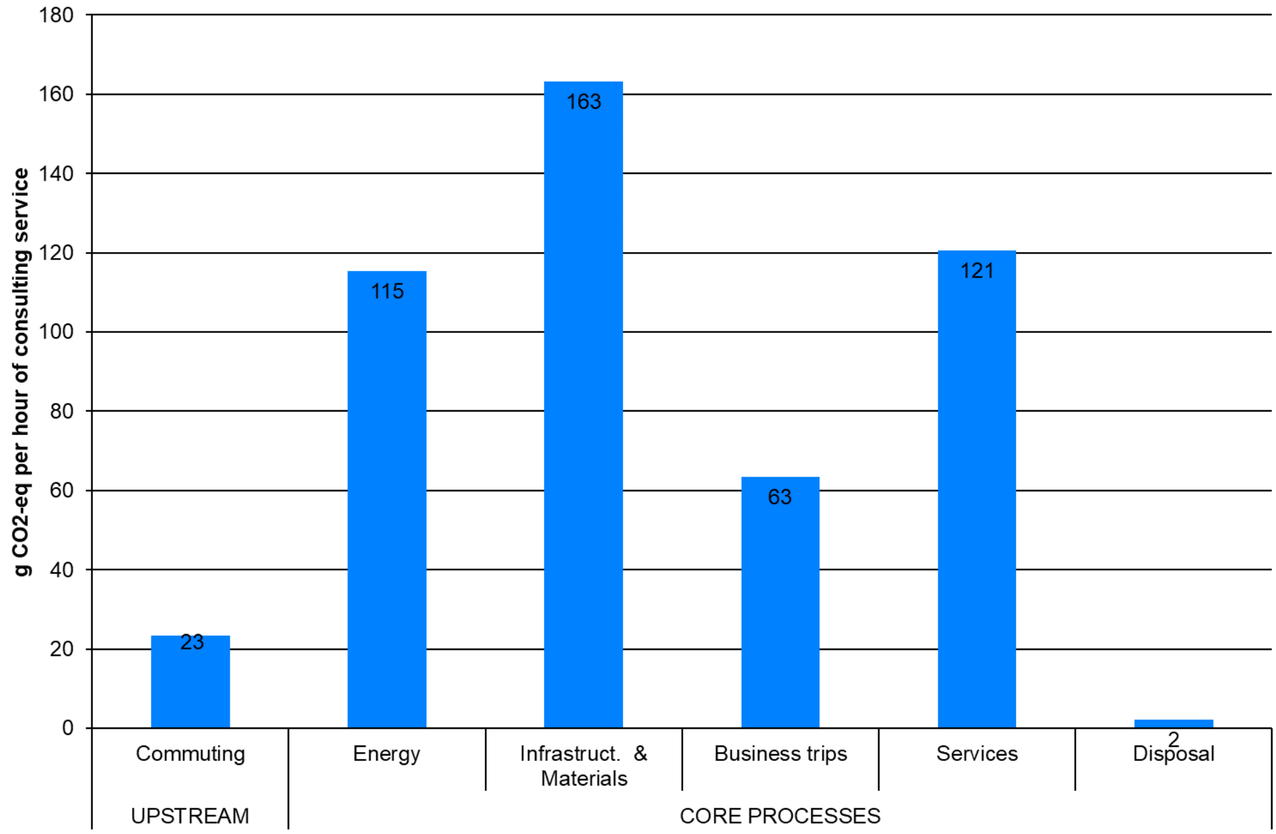


Fig. 4.1 Carbon footprint in kg CO_2-equivalents per hour of consulting service in 2023

4.4 Total environmental impacts according to ecological scarcity method

For our Swiss customers, information on the environmental impact points (UBP) calculated according to the ecological scarcity method 2021 (BAFU 2021) might also be of interest. These impacts are shown in Tab. 4.5 and Fig. 4.2.

The ecological scarcity method considers several types of environmental impact and resource use, which are weighted differently according to the objectives of Swiss environmental policy. The single score result reflects the results of most indicators assessed in the PEF method. Once again, the highest share is caused by the process infrastructure and materials, followed by services purchased and energy. As already seen in chapter 3, commuting contributes less than business trips according to this method, due to the aforementioned reasons. Again, disposal contributes the smallest share of the overall impact.

Tab. 4.5 LCIA with the ecological scarcity method 2021. Eco-points per hour of consulting (BAFU 2021) in 2023

	Unit	*UPSTREAM*	*CORE PROCESSES*					TOTAL	TOTAL without travel
		Commuting	Energy	Infrastruct. & Materials	Business trips	Services	Disposal		
Ecological scarcity 2021	UBP	98	175	402	154	314	9	1152	998
Shares		*8%*	*15%*	*35%*	*13%*	*27%*	*1%*	*100%*	*87%*

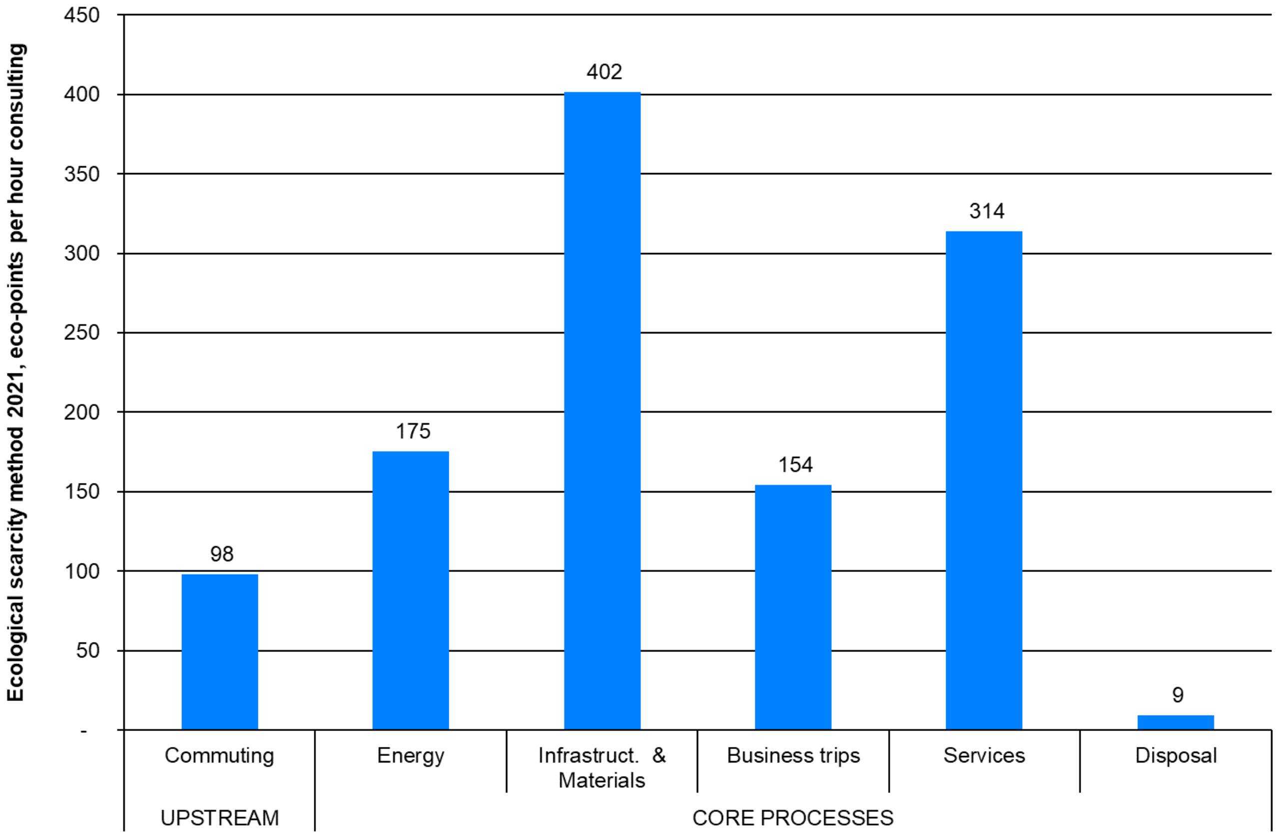


Fig. 4.2 LCIA with the ecological scarcity method 2021. Eco-points per hour of consulting (BAFU 2021) in 2023

4.5 Indicator results for use of resources and waste

If waste treatment is not included within the system boundaries, the EPD PCR require listing indicators for the use of resources and waste directly taken from the life cycle inventory. As this LCA includes the whole life cycle of all required products and services, it is not necessary to carry out this step.[4] All the related impacts are assessed.

5 Discussion of results

According to the product category rules (PCR 2012) for this type of service, it is possible to neglect materials in the balance sheet if they contribute less than 1% to the total environmental impacts. Practically, it seems almost impossible to determine. Our balance sheet neglects certain material inputs such as ballpoint pens. It was not possible to quantify the consumption of materials purchased only in insignificant quantities. In some cases, there is also an overlap in terms of which contributions can be better recorded through monetary annual accounts and which materials can be recorded directly.

In the product category rules (PCR 2012), external services such as accounting are not explicitly mentioned. Our balance shows that it accounts for a quite relevant share of the environmental impacts caused. Therefore, it is recommended to include them in the EPD of consulting services.

[4] Updated clarification regarding indicators for use of resources and waste: https://www.environdec.com/News-archive/#15922, online 27.07.2020

6 Our commitment to sustainability

The environmental reports published for the consulting services of ESU-services Ltd. show that the environmental impacts caused per consulting hour can be highly influenced by the number of business trips involving air travel. Air travel depends on the projects carried out and on visits to international congresses. In 2023, we were able to make most of the trips by train and in one case by an intercity coach and ferry.

The number of business trips and commuting was still smaller in 2023 compared to years before the corona crisis.

For travel by car, the company has a subscription with the car-sharing provider Mobility, which, however, hardly had to be used. The possibility of online telephone conferences has been intensively used to avoid travelling abroad.

Our suppliers are also chosen based on their sustainable performance. For example, we use recycled or FSC-certified paper. We use the naturemade star certified electricity “Naturstrom Schaffhausen” provided for this region by SH power.

Other factors, such as energy and water consumption and infrastructure, can only be influenced to a limited extent.

The social insurances are not considered this year. However, for staff pensions, ESU-services is a member of the "Abendrot" insurance company, which pursues a sustainable investment policy. Other insurance used by the company, such as AHV, are required by law and therefore cannot be influenced.

Commuting depends on where employees live and is therefore an individual decision. Since the beginning of the corona crisis, we work at home for a considerable share of working time and therefore avoid commuting.

We offer all staff members the opportunity to work parttime and in home office to support families and work-life balance. Salaries are based on performance and not influenced by age or gender. Additionally, we actively discourage structural overtime.

We actively support our customers in developing sustainable business practices. There are special consultancy rates for NGOs.

ESU-services cooperates closely with the global SimaPro network. With a wide range of expertise available, we can offer unparalleled services and facilitate large international or multi-client projects. Within the partner network, we have developed and expressed our ethical core values. Collaborating with partners all over the world is crucial for ESU-services as we work to meet the precise needs of our customers.

We strengthen our commitment to provide all types of media with reliable and transparent information about environmental aspects. The main topics presented were requests concerning sustainable food consumption. For this we elaborated an extensive report on recommendations for nutritional guidelines (Jungbluth et al. 2022). Many media outlets took advantage of our services and based their articles partly on contributions by ESU-services as shown in Tab. 6.1. A full list of articles can be found on our webpage.

Tab. 6.1 Media publications citing the works of ESU-services in 2023

Titel und Link	Quelle	Datum	Thema
Exotische Früchte und ihre lange Reise	SRF - Echo der Zeit	28.12.2023	«Da muss man die ganze Transportkette anschauen», sagt Niels Jungbluth, Spezialist für Ökobilanzen bei ESU-services.
Welcher Tannenbaum ist am nachhaltigsten?	Tagesanzeiger	19.12.2023	
Les immenses émissions grises des infrastructures routières ne font l'objet d'aucune évaluation	La Revue Durable	19.12.2023	
Der Bau neuer Autobahnen verursacht hohe graue Emissionen	Umverkehr	19.12.2023	
Gesucht: Nachhaltiger Weihnachtsbaum	Tagesanzeiger	16.12.2023	
Die Weihnachts-Ökobilanz: Gut für die Umwelt gibt es nicht!	RAI - Südtirol	13.12.2023	Viele Produkte werben damit, umweltfreundlich zu sein. Das ist ein Fake, sagt der Fachmann: Produkte oder Dienstleistungen, die gut für die Umwelt sind, gibt es nicht.
Welcher Tannenbaum grünt am grünsten?	Süddeutsche Zeitung	11.12.2023	
Christbäume sind oft Pestizid-Schleudern	InfoSperber	10.12.2023	ESU-Services hat 2019 die Ökobilanz verschiedener Bäume berechnet und bietet auch ein Ökobilanz-Rechnungstool an.
Wie nachhaltig sind Christbäume noch?	TeleTop	07.12.2023	
Tannenbaum, oh Tannenbaum, wie grün ist deine Ökobilanz? Tipps für einen nachhaltigen Weihnachtsbaum	Nordbayern	06.12.2023	
Online-Retouren sind schädlich fürs Klima und nicht ökonomisch	10 vor 10, SRF	13.11.2023	
Fleisch im Futter: Schlechte CO2-Bilanz bei Hund & Katze.	Klimaminute: rbb24	04.09.2023	Auch Haustiere schlagen in unserer #Ökobilanz zu Buche. Grund ist vor allem das Fleisch in ihrem Futter.
So entlarven Sie grünen Etikettenschwindel	Beobachter	24.08.2023	
Regional einkaufen hilft der lokalen Wirtschaft, der Umwelt aber nicht wirklich	NZZ	10.08.2023	
Nicht alles für die Katz: Wie man die Klimabilanz von Haustieren verbessern kann	ARD - Brisant	08.08.2023	Muss man bei drei Kindern drei Katzen haben oder reicht auch eine?
Greenwashing-Vorwurf: Was ist dran an den „wahren Preisen" von Penny?	Berliner Zeitung	02.08.2023	
Kanton will weniger Klöpfer an der Bundesfeier	SRF Regionaljournal Basel Baselland	31.07.2023	
Wie schädlich ist Fliegen fürs Klima wirklich?	Tagesanzeiger	21.07.2023	Christoph Meili, Ökobilanzierer bei ESU-services, sagt: «Wir müssen komplett weg von fossilen Energieträgern wie Erdöl, Erdgas und Kohle!»
Klima & Sport: Folge 3 - Reitsport	WDR 5 Sport inside Podcast: kritisch, konstruktiv, inklusiv	17.06.2023	In einer Podcast-Serie beleuchtet Sport inside welchen Anteil der Reitsport am und welche Auswirkungen der Klimawandel auf den Sport hat. Dabei geht es auch um die Ökobilanz
Warum sind Schweizer Spargeln so teuer?	Sonntagszeitung	28.05.2023	
#23 Öko-Nonsense aufdecken mit Niels Jungbluth	HONIGMELONEMOND	09.05.2023	Ein spannendes Gespräch mit Ernährungswissenschaftlerinnen die sich auch Gedanken zur nachhaltigen Ernährung machen
Essen aus der Dose ist besser als sein Ruf	SRF1	08.05.2023	Konservendosen haben punkto Nachhaltigkeit Vor- und Nachteile. Wichtiger ist letztlich, was drin ist.
Der ökologische Pfötchenabdruck - Wie viel CO2 stößt dein Haustier aus?	wetter.de	29.04.2023	Tipps zur klimafreundlichen Haltung
Nicht alles für die Katz: Wie man die Klimabilanz von Haustieren verbessern kann	MDR - Brisant	26.04.2023	Muss man bei drei Kindern drei Katzen haben oder reicht auch eine? Niels Jungbluth im Interview
Natascha Fässler nimmt neu in Kommission Einsitz	appenzell24	24.04.2023	«Wasser kann es auch mit einer geringen Umweltbelastung trumpfen.» Der Präsident verdeutlichte dies anhand einer Studie, welche die renommierte Schweizer Firma «ESU-services» durchgeführt hatte.
Wie umweltschädlich sind Hund, Katze und Goldfisch?	BRF Nachrichten	16.03.2023	hat ESU ausgerechnet, dass die Fütterung eines Hundes pro Jahr für den Planeten so schädlich ist wie eine 3.677 Kilometer lange Autofahrt
Wie Sie Tropenfrüchte mit gutem Gewissen genießen	Süddeutsche Zeitung Magazin	15.03.2023	
Wie schlecht sind Hunde und Katzen fürs Klima? So groß ist der CO2-Fußabdruck von Haustieren	Volksfreund	28.02.2023	"Jedes Hobby verursacht Umweltbelastungen", sagt ESU-services-Gründer Niels Jungbluth.
Haustiere und das Klima: So viel CO2 verursachen Katze und Hund - und was das für dich bedeutet	inFranken.de	21.02.2023	Neben Futter und Umweltbelastungen wurden hier auch häusliche Gegebenheiten wie der Wärmeverlust bei Einbau einer Wärmeklappe berücksichtigt.

7 Your partner ESU-services Ltd.

On the following pages we present ESU-services as your partner for projects in the field of life cycle assessment. If you would like to collaborate, you can book the date for a first meeting. You should receive an email with a calendar invitation and Teams link after choosing the time and date. Please check your Spam folder if you do not receive such an invitation or contact us by Email.

7.1 Experienced project team

Different experts work for ESU-services who are all experienced in the field of ecological assessment of life cycles and profit from a network of renowned experts in the fields required for the study. One person will be appointed as project manager at the start of the project. He or she will be the main contact for the customer. Other staff members might assist the work depending on experience and availability. Niels Jungbluth, CEO at ESU-services, will oversee the project lead.

7.1.1 Dr. Niels Jungbluth, chief executive officer (CEO)

Dr. Sc. Techn. ETH Zürich, Dipl.-Ing. TU Berlin

Niels Jungbluth is since 2006 owner and managing director of ESU-services Ltd.. He conducts critical reviews and validation according to different standards for case studies and inventory data. Niels is listed as an approved individual verifier for the international EPD® System and can also work for other EPD systems like IBU-Bau, PEP or KBOB. Niels Jungbluth is in the editorial board of the "Int. Journal of LCA" and in the board of the LCA foods conference.

Niels started working with ESU-services in 2000. Since starting with LCA in 1994, he has worked on more than 300 consultancy projects in the areas food, biomass, energy systems, building products, metals, input-output-analysis, sustainable consumption, as well as several other topics.

Niels Jungbluth studied environmental engineering at the Technical University of Berlin. He started working with LCA in 1994 and prepared his diploma thesis during a six-month stay at the TATA Energy Research Institute in New Delhi, where he carried out a life cycle assessment for cooking fuels in India. Between 1996 and 2000 he worked on a Ph.D. Project at the Swiss Federal Institute of Technology (ETH) in Zurich at the chair of Natural and Social Science Interface. His Ph.D. thesis on the environmental consequences of food consumption has been awarded the Greenhirn Prize 2000 by the German Öko-Institut. In this thesis, he investigated food consumption patterns by means of life cycle assessment.

7.1.2 Dr. Maresa Bussa, project manager

Dr. rer. nat. TU Munich, M.Sc. in Energy and Environmental Engineering

Dr Maresa Bussa is working as a project manager for ESU-services since 2020. Her main areas of responsibility are the management of our training centre, the development of automation solutions, the preparation of environmental product declarations and life cycle assessments in EU research projects. She also provides support for our SimaPro customers.

From 2017 to 2020, she worked as a research assistant at the Weihenstephan-Triesdorf University of Applied Sciences. She analysed the ecological and economic aspects of the use of cyanobacteria as part of an EU project. As part of her doctorate at the Technical University of Munich, she carried out life cycle assessments on various microalgae cultivation systems and extraction methods.

Maresa Bussa studied Energy and Environmental Engineering at the École des Mines de Nantes and the Technical University of Madrid. In her master's thesis, she analysed options for adapting to climate change on the Koh Rong archipelago in Cambodia.

7.1.3 Christoph Meili, project manager

M.Sc. ETH in Environmental Engineering

Christoph Meili is working as project manager for ESU-services since 2016. Here he is responsible for the regional SimaPro Centre for Switzerland, Germany, Austria and Liechtenstein. Main tasks therefore are SimaPro software sales and support in German speaking countries. Additionally he offers trainings and coaching for using the SimaPro software and conducting life cycle assessments as well as presentations on various topics related to life cycle assessments.

Since starting at ESU-services he also conducted several LCA projects e.g. on energy systems, Swiss commodity trade, food items and tap water.

Since 2012, Christoph Meili is also working part-time for WWF Switzerland. There he is responsible for content of a carbon footprint-calculator, tips for the environment and external enquiries on topics related to individual consumption.

Christoph Meili studied environmental engineering at ETH Zurich with major in ecological system design, air quality control and waste management, and in soil protection. In his master thesis he carried out a material flow analysis and LCA for hydrothermal gasification of biomass.

7.1.4 Martin Ulrich, project manager

M.Sc. ETH in Environmental Engineering

Martin Ulrich works as a project manager at ESU-services since 2021. Since then, he has completed various LCA projects in different industrial sectors such as the paper, chemical, machinery and food industries. Investigations around agricultural production, consumption and nutrition recommendations or LCAs of public institutions such as the Zurich City Parliament are also part of his field of experience. In addition, Martin Ulrich is responsible for data sales and the distribution of LCA databases for SimaPro. For this purpose, he manages the broad "data-on-demand" offer of ESU-services and is in daily contact with our customers and partners.

In 2020 Martin had his first experiences with ESU-services during a 6-month internship and returned to the company in 2021. Martin also worked as the team leader of a bicycle courier team of the Familie Wiesner Gastronomie AG. There he remains a bicycle courier which he sees as a good sporting balance.

Martin Ulrich studied environmental engineering at ETH Zurich with a major in ecological system design about resources management. In his master thesis he evaluated the relation between cost and environmental impact of products and services throughout the broad spectrum of consumption in Switzerland.

7.1.5 Samuel Solin, project manager

B.Sc. ZFH in environmental engineering

Samuel Solin did an apprenticeship as a chemical laboratory assistant at Dottikon ES and worked there in the wastewater laboratory. He then studied environmental engineering at the ZHAW Wädenswil, specializing in natural resources and renewable energies. In his bachelor thesis, he conducted a feasibility study on a possible power-to-gas plant at a sewage treatment plant in the canton of Zurich.

From 2017 to 2022 he worked as a research assistant at the University of Applied Sciences Northwestern Switzerland. As part of this activity, he carried out life cycle assessments for various products, services, and companies, such as edible insects, Swiss shrimp, and all locations of the University of Applied Sciences Northwestern Switzerland. Samuel Solin has been working for ESU-services since 2022. While working at ESU-services, EPDs were conducted for a construction product and various switch cabinets, as well as life cycle assessments for various medical devices, coffee and - with a chemical focus – a resin for the plastics industry. He also helps with SimaPro sales and support.

7.2 Environmental and social responsibility

We care about the environmental impacts and other sustainability aspects with regards to the services offered. Our environmental key figures and sustainability related information is reported annually. The service offered in one of our projects also causes an environmental impact. ESU-services has developed a key parameter model which allows calculation of the impacts per project (Jungbluth & Solin 2024; PCR 2012). Business trips are key factor for the impacts of single projects. Therefore, they are calculated separately from the general impacts of the service per consulting hour. Tab. 7.1 shows an example for the calculation of impacts due to executing a project. We can also report the true environmental impacts of our services after finalization of the project without any extra costs for the commissioner.

Tab. 7.1 Example calculation of the environmental impacts due conducting a consulting project at ESU-services

Calculation of impacts per project		Expenses	Greenhouse gas emissions	Ecological scarcity method	Environmental Footprint 3.1
			kg CO2-eq	UBP'21	Points
Time budget consultancy	d	12.3	42	98’169	6.2E-03
Train trips, CH	km	100	1	3’050	8.7E-05
Train trips, DE	km	500	15	31’121	1.5E-03
Airplane travel	km	-	-	-	-
Hotel nights	-	2	45	102’537	3.9E-03
Total			**103**	**234’877**	**1.2E-02**

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7.3 Global Partner Network

ESU-services cooperates closely with partners in the global SimaPro network. With a wide range of expertise available, we can offer you unparalleled services and facilitate large international or multi-client projects. We can easily contact these partners to get access to data or information in all regions of the world. Collaborating with partners all over the world is crucial for ESU-services as we work to meet your precise needs. Furthermore, we share the following ethical values and commitments with this network.

Science-based sustainable solutions are for everybody:

- We love our planet, it's our home.
- We work to restore its resilience through sustainable practices and metrics.
- LCA is at the heart of sustainability metrics and must be accessible for everybody.
- SimaPro and LCA-based practices will be pivotal in a vibrant ecosystem that connects a diversity of worlds, systems, people.
- Within that ecosystem we will co-create solutions together with clients, partners, fellow companies, and each other.

Our commitments:

- We commit to quality, accuracy, and transparency.
- We commit to the fact-based results. We won't engage in fact-distortion.
- We use our experience and knowledge to inform our customers and to facilitate sustainable development and practices (co-create better solutions).
- We take every opportunity to maximise our positive impact.
- We welcome everybody to embrace a sustainable transition and see them as a collaborator.

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