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Can we rebuild planet Earth?

A case study of the Tales by Trees model for net positive art & design

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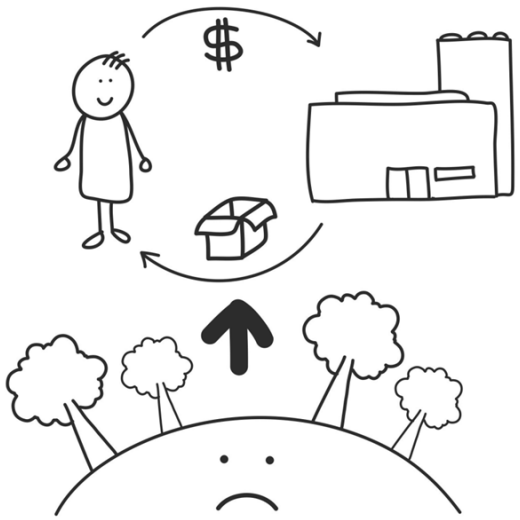
1. Problem and Solution

Problem

The problem is that we consume more ecological resources than nature can regenerate. This is because of activities like overfishing, overharvesting forests, overuse of agricultural land, mining, construction and emitting more carbon dioxide into the atmosphere than forests can sequester.

By August 2, 2017, we had used more from nature than our planet can renew in the whole year. Our debt to nature has been increasing alarmingly fast year by year. Fairly soon we will need two planets to meet our yearly consumption. But we only have one.

So far the discussions and solutions to the problem have focused mainly on how to decrease consumption, how to use natural resources more efficiently or how to recycle and upcycle resources. In some rare cases there has been some efforts to remedy the problem by businesses or countries with environmentally oriented politics, but mainly it has been undertaken by non-profit organizations and their supporters. However, perhaps the interplay between governments, activists, and consumers is not the relationship we should focus on. Shouldn't we focus on where consumption actually happens? The vast majority of consumption happens as a result of global business-consumer relationships.



Like in most relationships both parties are responsible for the outcome. And just pointing the finger at businesses or just at consumers takes us nowhere. Businesses sell us what we buy or there is no relationship, and by buying we choose to stay in this relationship. If this relationship is not changed in a way that also accounts for the interests of nature, our future looks terribly dark. But let's not go there just yet. We have an idea.

Solution

Our question is the following: *Is it possible to organize a business that sells physical goods globally in such a manner that it puts back more into the environment than it takes out?* In other words, can a business-consumer relationship be net positive? Is it possible to have a relationship that rebuilds planet Earth? That sounds like a relationship you want to be in!

In the next chapter, we will present the scientific concepts and methods relevant for testing the idea. In Chapter 3 we will test the framework in a real life business-consumer relationship case study, followed by the net positive impact discussed in Chapter 4. In Chapter 5, we have the conclusion, and finally in Chapter 6 all the data sheets, certificates, references and suggestions for further reading. We hope you find this case study interesting and inspiring to read!

2. Scientific Models

In this chapter the most relevant scientific concepts and methods for calculation are presented. The concepts are Life Cycle Assessment and Net Positive. This is followed by three relevant methods for calculating environmental impacts. These are *material footprinting* (*Ecological Rucksack*), *carbon footprinting* and *handprinting*.

Life Cycle Assessment (LCA)

Life cycle assessment is a method to assess environmental impacts associated with all the stages of a product's life cycle, from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. In order to be able to conduct a life cycle assessment, an inventory needs to be conducted of the relevant inputs, such as energy and material, and outputs, such as environmental emissions. Environmental impacts related to the inputs and outputs are assessed. With this information it is possible to identify the most harmful phases of the life cycle and then take appropriate changes to the process.

Net Positive

The term “net positive” means that the sums of negative and positive actions are in the end positive. The positive can be, for example, a reduction of greenhouse gas emissions to the atmosphere. It can also be a more abstract positive with social, economic, or other environmental aspects.

Net positive thinking is also a new way of doing business. The major goal is to produce more beneficial than destructive impacts to the environment or society.

The net positive analysis begins with assessing the key material areas for a business. It can be greenhouse gas emissions, water use, or other material use. The key material areas are analyzed, for which we will use lifecycle-wide assessment methods. The aim is to decrease the impacts first and then increase methods to give more to the environment than is taken from it.

The leading groups behind net positive thinking are organizations like The Net Positive Project, Center for Health and the Global Environment (Harvard University), Forum for the Future, BSR (Business for Social Responsibility), The Climate Group and WWF. The Net Positive Project has settled on four core principles that define the concept of net positivity:

Material - Focusing on what matters most

Regenerative - Creating positive self-replicating cycles in nature and society

Systemic - Influencing change beyond an organization’s four walls

Transparent - Sharing progress honestly

Material Footprint (Ecological Rucksack)

An Ecological Rucksack is the total quantity of materials in kilograms taken from nature to create a product or service. Ecological Rucksacks look at hidden material flows. Ecological Rucksacks take a life cycle approach and signify the environmental strain or resource efficiency of the product or service. The calculation includes the use of air, water, abiotic (lifeless), biotic (living) and soil materials. Air and water consumption are usually considered separately from the rest of the materials due to their different characteristics and the large amount of water. If they were added up in the calculations, the results would mostly tell about the water usage of the process and the other aspects would be lost. The whole production process is considered from the raw materials to the end-product. There is a rucksack factor (MIT = material intensity), which describes the average total amount of materials used to produce e.g. 1 kg of a raw material. With the MIT-factors and the weights of used material, it is possible to calculate the Ecological Rucksack of a product or service.

Carbon Footprint

The footprint is a measure that describes the amount of natural resources or environmental impacts that are used or caused by a business, a single product, or even a country or a person. The carbon footprint is about greenhouse gas emissions, the water footprint about water use, and so on. There are many different definitions of the concept, one of which is that the carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product. Usually the calculations also include other greenhouse gas emissions, besides carbon dioxide (CO_2), and their climate effects are compared to the effects of CO_2. Therefore, the carbon footprint's unit is kg of CO_2 equivalents (CO_2eqv). Footprint calculations are based on lifecycle assessment and the whole lifecycle, from raw material extraction to the product's end-of-life, is included in the calculations.

Handprint

Handprinting is footprinting's counterpart. It measures the positive effects a business, product or a person causes. One can never reduce a footprint to zero, but by growing a handprint and doing more good than harm, one can compensate for a footprint. One of the main developers and thinkers behind the concept of "handprints" is Gregory A. Norris (PhD, Natural Resources) who serves as Co-Director at Harvard School of Public Health.

The most fundamental thing to understand about handprinting is the following: One cannot compensate X by Y. One can only compensate X by X. So, if the key material of a product is plastics, as in a non-renewable oil based material, it cannot be compensated by tree planting, as in an organic, renewable, wood based material. If a textile business uses child labor in China, this cannot be compensated by employing seniors in France.

There are many ways to increase the handprint, but not very accurate ways to measure it. This is not because it isn't doable, but because the concept of handprint is still fairly new and more research has to be done. It's like any new, emerging technology; you realize that today it does this, but tomorrow it will be more sophisticated. Some examples of actions that increase the handprint are a water intense business producing more drinkable water rather than using water in production of a product, or a business using a lot of wood and planting more trees than they fell, or a person using a LED lamp instead of a regular light bulb. These actions are clearly measurable. However, working for better rights for girls and women, for example, is also a way to increase the handprint. It's just not as easily measurable as water purification or tree planting, but it's still counted to increase the handprint.

In the next chapter we will use these models and concepts in a real life business-consumer relationship case study.

3. Case Study

TALES BY TREES

Tales by Trees is a net positive art & design company based in Finland. The company offers products to consumers worldwide via e-commerce with carbon neutral home delivery.

As an early stage start-up company, the first offering is limited to two products, The Seed, a design sculpture by award winning Finnish designers Saara Renvall and Elina Helenius, and the Book Trilogy, an illustrated art book series by award winning author Iiro Küttner and graphical artist Ville Tietäväinen.

All the materials, packaging, transports, production, door-to-door delivery and end-of-life are analysed. Based on this information the material footprints, carbon footprints and handprints are calculated separately for both products. These concepts are life cycle assessment (LCA) based, and therefore we will not be using LCA separately for the analysis.

The company shares an office space in Helsinki and has currently two full-time employees and three part-time, in total 3.5 full-time employees. The company works currently with some 10 scientists, artists, designers and other specialists on a freelance basis. Since these persons are living and working regardless of whether they are being paid by the company, we have decided to exclude emissions caused by them from these calculations (mainly laptops and mobile phones).

In our calculations, we have estimated that the carbon footprint of our daily office operations is 3,932 kg CO_2 eqv. per year. This is mainly from the energy needed for heating, laptops and mobile phones, and some minor product assembly, polishing and packaging activities. The estimate is based on an average individual yearly carbon footprint in Finland divided by the amount of working days per year. This is compensated by planting 1366 trees.

The material footprint is estimated to be 11,323 kg, which is compensated by protecting 227 m^2 of forest.

When the company grows, these numbers will be re-calculated and compensated accordingly.

Please note: In case some data points might be incomplete or we feel the estimation might not be sufficiently reliable for any reason, we have overestimated the negatives and underestimated the positives to our disadvantage. All the data sheets and calculations are presented in chapter 6.

Product 1: The Seed

The total physical product consists of the *actual product*, the Seed (1,6 kg, 23 x 16 cm), its *production*, *packaging*, some minor *add-ons*, like sheets of paper for shipment details, and all the *transportations.* The total physical product is analyzed. First we will use the material footprint method, then the material handprint, followed by the carbon footprint, and finally the carbon handprint.

The Material Footprint (Ecological Rucksack)

In order to calculate the Ecological Rucksack for the total physical product, all weights are measured separately. All the 5 different categories, including abiotic, biotic, earth movements (soil), water and air, have their own MIT-factors based on the Wuppertal Institute's calculations.

After all material use is calculated, they are summed together by different categories. Usually the amounts of material used to produce the product are described as the material footprint, a sum of all abiotic and biotic resource use and the topsoil erosion in agriculture and forestry.

Actual product: The key material of the Seed is PEFC-certified birch from Nordic forests. PEFC-certified forest means that when a forest is felled, it's replaced by planting new trees and that some measures are taken to maintain biodiversity. Although 70-75% of the land area of Finland is covered in forests, no separate MIT-factors for Finnish trees exist yet, so we have (as a best available proxy) used factors for trees grown in Germany. The material footprint for the actual product is 8.94 kg.

Production: Production means all energy used to produce the actual product and its package. The material footprint of the production is 1.35 kg.

Transportations: Transport means all transportations of the total physical product from raw material extraction to production site and finally to the company office. In order to calculate the material footprint for the transport, all the transport routes of the total physical product need to be calculated by distance (km), by the type of transportation (boat, train, truck or airplane), and by type of energy used for transportation. The material footprint for the transportations is 3.12 kg.

Package: The package consists of the actual box and packing materials inside the box for holding the Seed in place during shipment to customer. The packing materials are made out of non-certified renewable and recycled material, basically cardboard. The box is made out of certificated cardboard (FSC Mix). The material footprint for the package is 0.75 kg.

Add-ons: 4 paper sheets inside the box for information purposes, packaging list envelope and 2 sheets for shipment details. The material footprint for the add-ons is 0.47 kg.

When the sum of all of the material use and transportations are calculated, we get the material footprint.

The material footprint for the total physical product is 14.63 kg.

Material Handprinting

The purpose of conserving old forests is to save more natural resources that have been used for the total physical product. One square meter (1 m^2) of old forest is equivalent to 50 kg of natural resources according to Luyssaert et al (see references). For each Seed produced and delivered to our customer we conserve 10 m^2 of old forest, which means 500 kg of natural resources conserved. When the material footprint 14.63 kg is subtracted, we see that *every Seed conserves more than 485 kg of resources*. Based on these figures, we can say that the Seed conserves *33 times the amount of resources used*. The company conserves old forest in Finland through the Finnish Natural Heritage Foundation.

Please note that in our marketing we have opted to use significantly lower multipliers to be absolutely certain that we can fulfil all promises that we make to our customers, even in the case some unforeseen circumstances would come up.

The Carbon Footprint

The carbon footprint is calculated using CO_2 eqv emissions, which means all the greenhouse gas emissions transformed comparable to CO_2 emissions.

The total physical product consists of the *actual product*, The Seed, its *production*, *packaging* and some minor *add-ons*, like sheets of paper for shipment details, and all the *transportations* needed to get the total physical product in one place. Also, the *shipment* and *end-of-life* are included. The total physical product is analyzed.

Actual product: The carbon footprint for the actual product is 0.74 kg CO_2 eqv.

Production: The carbon footprint of the production is 0.01 kg CO_2 eqv.

Transportations: The carbon footprint for the transportations is 0.95 kg CO_2 eqv.

Package: The carbon footprint for the package is 0.40 kg CO_2 eqv.

Add-ons: The carbon footprint for the add-ons is 0.04 kg CO_2 eqv .

Shipment: Shipment means shipment of the total physical product from the company premises to the doorstep of the consumer. The total carbon footprint caused by shipment of the total physical product depends on the location and the available mode of transportation. We have partnered with a shipment company offering global carbon neutral door-to-door delivery. This means that the shipment company calculates the carbon footprint and offsets all emissions caused by our shipments globally. Therefore, we use value 0 for carbon footprint for the shipment of the total physical product.

End-of-life: The Seed is a non-perishable wooden design object with a theoretically extremely long lifetime. As an example, the Shigir Idol, the world's oldest known wooden statue, is currently 11,000 years old. Therefore, doing an end-of-life assessment for the Seed is challenging. Nevertheless, the Seed would degrade naturally and form nutritious soil improving matter. This applies for the packaging and add-ons as well. Therefore, we use value 0 for carbon footprint for the end-of-life of the total physical product.

The total carbon footprint for the total physical product is 2.13 kg CO_2 eqv.

Carbon Handprinting

The purpose of our tree planting is to sequester more CO_2 from the atmosphere than has been emitted due to the making of the total physical product (The Seed). The company plants trees in Sub-Saharan Africa,

where one tree sequesters 2.88 kg of CO_2 in one year. For each Seed produced and delivered to our customer, we plant 50 trees, which means 144 kg of CO_2 sequestered in one year. When the carbon footprint for the total physical product (2.13 kg) is subtracted, we see that *every Seed sequesters over 141 kg of CO_2*. Based on these figures, we can say that the Seed *sequesters 66 times the amount of CO_2 emitted*. The company plants trees with Trees for the Future, a U.S. based non-profit organization.

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Product 2: The Book Trilogy

The total physical product consists of the *actual product*, the Book Trilogy (as in three separate hard cover books), its *production*, *packaging* and some minor *add-ons*, like sheets of paper for shipment details, and all the *transportations* needed to get the total physical product in one place. The total physical product is analyzed. First we will use the material footprint method, then the material handprint, followed by the carbon footprint, and finally the carbon handprint.

The Material Footprint (Ecological Rucksack)

Actual product: The key material of the Book Trilogy is FSC-certified paper from sustainably managed forests (FSC Mix). Sustainably managed forest means, among other positive things, that when a tree is felled, it is replaced by planting a new tree and clear cutting is avoided to maintain biodiversity. The material footprint for the actual product is 5.95 kg.

Production: Production means all energy used to produce the actual product and its package. The material footprint of the production is 0.45 kg.

Transportations: Transport means all transportations of the total physical product from raw material extraction to production site and finally to the company office. In order to calculate the material footprint for the transport, all the transport routes of the total physical product need to be calculated by distance (km), by the type of transportation (boat, train, truck or airplane) and by type of energy used for transportation. The material footprint for the transportations is 1.56 kg.

Package: The package consists of an envelope shaped box made out of certificated cardboard (FSC Mix). The material footprint for the package is 0.28 kg.

Add-ons: 4 paper sheets inside the box for information purposes, packaging list envelope and 2 sheets for shipment details. The material footprint for the add-ons is 0.59 kg.

When the sum of all of the material use and transportations are calculated, and the weight of the product is subtracted from the total weight, we get the material footprint.

The material footprint for the total physical product is 8.84 kg.

Material Handprinting

The purpose of our conservation of old forests is to save more natural resources than have been used for the total physical product (The Book Trilogy). One square meter (1 m^2) of old forest is equivalent to 50 kg of natural resources according to . For each Book Trilogy produced and delivered to our customer we conserve 5 m^2 of old forest, which means 250 kg of natural resources conserved. When the material footprint 8.84 kg is subtracted, we see that *every Book Trilogy conserves more than 240 kg of resources*. Based on these figures, we can say that every Book Trilogy conserves *27 times the amount of resources used*. The company conserves old forest in Finland with the Finnish Natural Heritage Foundation.

Please note that in our marketing we have opted to use significantly lower multipliers to be absolutely certain that we can fulfil all promises that we make to our customers, even in the case some unforeseen circumstances would come up.

The Carbon Footprint

The carbon footprint is calculated using CO_2 eqv emissions, which means all the greenhouse gas emissions transformed comparable to CO_2 emissions.

The total physical product consists of the *actual product*, The Book trilogy, its *production*, *packaging* and some minor *add-ons*, like sheets of paper for shipment details, and all the *transportations* needed to get the total physical product in one place. Also the *shipment* and *end-of-life* are included. The total physical product is analyzed.

Actual product: The carbon footprint for the actual product is 0.69 kg CO_2 eqv.

Production: The carbon footprint of the production is 0.36 kg CO_2 eqv.

Transportations: The carbon footprint for the transportations is 0.26 kg CO_2 eqv.

Package: The carbon footprint for the package is 0.16 kg CO_2 eqv.

Add-ons: The carbon footprint for the add-ons is 0.04 kg CO_2 eqv .

Shipment: Shipment means shipment of the total physical product from the company premises to the doorstep of the consumer. The total carbon footprint caused by shipment of the total physical product depends on the location and the available mode of transportation. We have partnered with a shipment company offering global carbon neutral door-to-door delivery. This means that the shipment company calculates the carbon footprint and offsets all emissions caused by our shipments globally. Therefore, we use value 0 for carbon footprint for the shipment of the total physical product.

End-of-life: The Book Trilogy is an art book series with a theoretical life time of several hundreds of years. Museums and auctions frequently feature books of this age. Therefore, doing an end-of-life assessment for the Book Trilogy is challenging. Nevertheless, the books would degrade naturally and form nutritious soil improving matter. This applies for the packaging and add-ons as well. Therefore, we use value 0 for carbon footprint for the end-of-life of the total physical product.

The total carbon footprint for the total physical product is 1.51 kg CO_2 eqv.

Carbon Handprinting

The purpose of our tree planting is to sequester more CO_2 from the atmosphere than has been emitted due to the making of the total physical product (Book Trilogy). The company plants trees in Sub-Saharan Africa, where one tree sequesters 2.88 kg of CO_2 in one year. For each Book Trilogy produced and delivered to our customer, we plant 25 trees, which means 72 kg of CO_2 sequestered in one year. When the carbon footprint for the total physical product, 1.51 kg, is subtracted, we see that *every Book Trilogy sequesters over 70 kg of CO_2*. Based on these figures, we can say that every Book Trilogy *sequesters 46 times the amount of CO_2 emitted*. The company plants trees with Trees for the Future, a U.S. based non-profit organization.

Please note that in our marketing we have opted to use significantly lower multipliers to be absolutely certain that we can fulfil all promises that we make to our customers, even in the case some unforeseen circumstances would come up.

4. Net Positive Impact

Net Positive Project has created four principles to help companies reach net positivity. The following discussion presents these principles (*Material*, *Regenerative*, *Systemic* and *Transparent*) as well as the ways Tales by Trees implements them.

Material

Focusing on what matters most: Net positive strategies focus on those social and environmental issues most impacted by a business and its value chain, as identified by internal and external stakeholders on a routine basis. A positive impact or 'handprint' in one material issue must not compensate for the negative impact or 'footprint' in another material issue.

Tales by Trees: Our key material areas are the sufficiency of wood resources, climate, and biodiversity. Our positive impact is made by planting trees to cover our material use and to offset carbon emissions, and by conserving old forests to increase biodiversity and to prevent the use of those resources in the future.

One Seed sold results in the planting of 50 trees and the conservation of 10 m^2 old forest.

One felled tree gives material for 25 Seeds, meaning 1,250 trees are planted and result in the sequestering of 3,525 kg of CO_2. Every tree felled for the Seeds results in the conservation of 12,125 kg natural resources.

As for the Book Trilogy, every trilogy sold results in 5 m^2 conserved forest, meaning 250 kg of natural resources protected for the future. Every trilogy sold also results in the planting of 25 trees, meaning 72 kg of CO_2 sequestered.

Regenerative

Creating positive self-replicating cycles in nature and society: Net positive revitalizes the natural world, strengthens communities, improves individual well-being, and strives for long-term positive impact. Net positive does not cause irreversible damage to the environment, society, or individuals. If new activity resulting from a net positive strategy negatively impacts a company's material issues, these would need to be added to the company's footprint hurdle & addressed without irreversible loss.

Tales by Trees: Our products are almost entirely made of renewable bio-based materials. These materials are from sustainable sources that do not cause irreversible natural damage. Ethical practices in recognising individual and community rights are equally important to us, both in terms of selecting resource sources as well as throughout the entire supply chain. The tree planting activities provide economic and social value to local communities.

We are an art & design company. Art & design contributes both to individual and collective well-being. Recent studies also show that constant exposure to wood furniture and interiors produces significant benefits on one's health, similar to those obtained by spending time in natural surroundings.

Systemic

Influencing change beyond an organization's four walls: Net positive strategies catalyse positive change from cradle to grave in order to positively impact entire social, environmental, and economic systems. These strategies recognize that just addressing a single organisation's behaviour would not significantly change outcomes to society and the environment. These systems, and their underlying relationships, are dynamic and must be continually reassessed to ensure greatest impact.

Tales by Trees: In order to create positive impacts, we partner with Non-Governmental-Organizations such as: the U.S. based Trees for the Future, The Finnish Natural Heritage Foundation, Clic Innovation (an open innovation cluster within bioeconomy, energy and cleantech in Finland), companies such as Tyrsky

Consulting (Kati Berninger and Oras Tynkkynen from Tyrsky Consulting actually published a book about Net Positivity in 2017), D-mat (Michael Lettenmeier) for climate and material consulting and modelling, and finally with a number of independent academic researchers. Naturally, we also work closely with companies in our supply chain, such as DHL for carbon neutral home delivery services. We will continuously increase our networking efforts.

With our net positive agenda, we challenge conventional thinking and business models in the traditionally highly wasteful consumer goods markets. We do this for instance by our choice of distribution models (global e-commerce with carbon neutral delivery) and our minimizing the use of packaging materials by innovative designs. We will continue working closely with the brightest minds in the upcoming field of wood fibre based materials, such as composites and textiles, thus introducing new net positive products.

Going forward, we see a role for us in educating both decision makers as well as the business community about what we have learned and continue to learn from our commitment to net positivity. By insisting on reducing emissions and waste throughout our production pipelines and supply chains, we can similarly have an influence on our suppliers' understanding of net positive thinking, making any future transition towards positive change easier for them. As a forest based brand, we are also especially interested in making sure that sustainable forestry standards are propagated and improved.

Transparent

Sharing progress honestly: Net positive requires actions, progress, and measurement that are clear, credible, and easily accessible in communications. Attribution of all material impacts – both positive and negative – must be measurable and demonstrable.

Tales by Trees: Our net positive impact is clearly demonstrable. The protected forest areas provide a habitat for endangered species and increase the biodiversity. The trees planted sequester far more CO2 from the atmosphere than we produce. Our calculations are based on data from recent scientific studies and our partners and the models used are generally accepted in the scientific society. All materials will be publicly available.

Tales by Trees reports all the measures taken to reach net positivity. This reporting will openly show all data, models, and calculations, as well as information about offsetting practices. Everything is written in a clear, understandable language for all interested parties to read.

5. Conclusion

First we stated the problem of overconsumption, then we presented the science and used it to conduct a business-consumer relationship case study, including the footprint and handprint calculations. But do you remember the initial question? *Is it possible to organize a business that sells physical goods globally in such a manner that it puts more back into the environment than it takes out?*

Yes, it is.

6. Data Sheets, Certificates, References and Further Reading

Data Sheets

Office			**Abiotic material**		**Biotic material**		**Earth movements**		**Water**		**Air**	
Substance name	*Unit*	*Amount*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*
Working area (office)	m2	100	65	6500	-	-	-	-	0	0	2	200
Heating (office)	kWh	5300	0,49	2597	-	-	-	-	0	0	0,36	1908
Electricity (used in the office and home)	kWh	4200	0,53	2226	-	-	-	-	0	0	0,22	924
Sum				11323		0		0		0		924
	kg material used											
Sum (abiot + biot + water+erosion)	11323											
Sum (air)	924											
Sum (all)	12247											
Ecological rucksack	12247											

Carbon footprint calculation of the office

Component	Value	Unit	Reference material/ used coefficient	Total (kg CO_2 eqv.)
Office building	100	m^2	Multi-storey building. [1]	1002,4
Office, heating	100	m^2	Distric heating, Finland. [1], [3], [4]	1423,1
Office, electric consumption	1200	kWh/employee/a	Finnish electricity, mix. [1]	315,0
Home office, electric consumption	1200	kWh/employee/a	Finnish electricity, mix. [1]	630,0
Total kg CO_2 eqv. / year				**3370,5**
Total kg CO_2 eqv. / person / year				**1123,5**
Total kg CO_2 eqv. / month				**280,9**
Total kg CO_2 eqv. / person / month				**93,6**

Sources for reference materials/used coefficients:

[1] Ecoinvent V3.3. Environmental impact, global warming potential (GWP) 100a.

[2] Ecoinvent V2.2. Environmental impact, global warming potential (GWP) 100a.

[3] Salonen M., Nissinen, A., Mattinen, M. & Manninen, K. 2016: How is the carbon footprint calcluated in the Ilmastodieetti tool?

[4] Airaksinen, M. & Matilainen, P. 2011: A carbon footprint of an office building. Energies 4: 1197-1210.

Seed (birch) package			**Abiotic material**		**Biotic material**		**Earth movements**		**Water**		**Air**	
Substance name	*Unit*	*Amount*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*
Wood (birch)	kg	1,665	0,86	1,4319	5,51	9,17415	-	-	0	0	0,13	0,21645
Cardboard	kg	0,463	1,86	0,86118	0,75	0,34725	-	-	0	0	0,33	0,15279
Paper (bleached)	kg	0,044	9,17	0,40348	2,56	0,11264	-	-	0	0	1,28	0,05632
Glue (one component PVAc glue)	kg	n/a										
Sum		2,172		2,69656		9,63404		0		0		0,42556
	kg material used											
Sum (abiot + biot + water+erosion)	12,3306											
Sum (air)	0,42556											
Sum (all)	12,75616											
Ecological rucksack	10,1586											

Carbon footprint calculation of the Seed

Component	Value	Unit	Reference material/ used coefficient	Total (kg CO_2 eqv.)
Seed (wooden material)	0,014	m3	Sawn timber, hardwood, raw.[2)]	0,736
Manufacturing	2,543	kWh	Electric production, hydro, run-of river, Finland. [1)]	0,011
Seed (birch)	1,665	kg		
Cardboard box (recycled fibers from Sweden/Finland)	0,149	kg	Corrugated board box production.[1)]	0,128
Cardboard holders (recycled fibers from Sweden/Finland)	0,314	kg	Corrugated board box production.[1)]	0,269
Paper (A4*3 + envelope*2)	0,044	kg	Paper, woodfree, uncoated paper.[1)]	0,039
Total (kg CO_2 eqv., wooden material and packaking)				**1,18**

Transportations	Value	Unit	Reference material/ used coefficient [1)]	Total (kg CO_2 eqv.)
Seed				
Wood transported from forest to production	330	km	Transport, lorry, 16-32t, EURO3.	0,450
From production to ofiice (Sievi - Helsinki)	500	km	Transport, lorry 3.5-7.5t, EURO3.	0,427
Cardboard box				
From forest to cardboard production	n/a	km	*	
From production to folding to boxex (n/a-Tirol)	n/a	km	*	
From production to harbour (from Tirol to Tallin)	2215	km	Transport, lorry, 16-32t, EURO3.	0,054
Cargo ship (from Tallin to Helsinki)	82	km	Transport, transoceanic freight ship.	0,0001
From harbour to office (inside Helsinki)	40	km	Transport, lorry 3.5-7.5t, EURO3.	0,003
Cardboard holders				
Recycled fibers to cardboard holder production (Sweden/Fir	n/a	km	*	
From production to office (Loviisa - Helsinki)	100	km	Transport, lorry 3.5-7.5t, EURO3	0,016
Total (kg CO_2 eqv., transportation)				**0,95**
TOTAL (kg CO_2 eqv., product + transportation)				**2,13**

Sources for reference materials/used coefficients:

1) Ecoinvent V3.3. Environmental impact, global warming potential (GWP) 100a.

2) Ecoinvent V2.2. Environmental impact, global warming potential (GWP) 100a.

3) Salonen M., Nissinen, A., Mattinen, M. & Manninen, K. 2016: How is the carbon footprint calcluated in the Ilmastodieetti tool?

4) Airaksinen, M. & Matilainen, P. 2011: A carbon footprint of an office building. Energies 4: 1197-1210.

Book package			**Abiotic material**		**Biotic material**		**Earth movements**		**Water**		**Air**	
Substance name	*Unit*	*Amount*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*	*MI-Factor kg/unit*	*kg/unit Main product*
Product												
Paper (bleached)	kg	0,5125	9,17	4,699625	2,56	1,312	-	-	0	0	1,28	0,656
Cardboard	kg	0,2765	1,86	0,51429	0,75	0,207375			0	0	0,33	0,091245
Ribbon (viscose)	kg	0,001	9,23	0,00923	2,37	0,00237	-	-	-	-	-	-
Package												
Paper (bleached)	kg	0,055	9,17	0,50435	2,56	0,1408	-	-	0	0	1,28	0,0704
Cardboard	kg	0,173	1,86	0,32178	0,75	0,12975	-	-	0	0	0,33	0,05709
Sum		1,018		6,049275		1,792295				0		0,874735
	kg material used											
Sum (abiot + biot + water)	7,84											
Sum (air)	0,87											
Sum (all)	8,72											
Ecological rucksack	6,82											

Carbon footprint calculation of Book trilogy

Component	Value	Unit	Reference material/ used coefficient [1)]	Total (kg CO_2 eqv.)
Books (3pcs.)				
Paper inside	0,473	kg	Paper, woodfree, uncoated paper.	0,41
Cover paper	0,040	kg	Paper, woodfree, uncoated paper.	0,03
Cover cardboard	0,277	kg	Corrugated board box production.	0,24
Ribbon (viscose)	0,001	kg	Viscose	0,00
Band around the books (paper)	0,011	kg	Paper, woodfree, uncoated paper.	0,01
Cardboard box	0,173	kg	Corrugated board box production.	0,15
Certificate of authenticity + envelope (paper)	0,020	kg	Paper, woodfree, uncoated paper.	0,02
Packing list (2*A4 papers) + envelope (paper)	0,024	kg	Paper, woodfree, uncoated paper.	0,02
Manufacturing books and cardboard boxes	0,846	kWh	Electricity production mix, Estonia.	0,36
Total (kg CO_2 eqv., books and packacking materials)				**1,25**

Transportation (From Forest to Office)	Value	Unit	Reference material/ used coefficient [1)]	Total (kg CO_2 eqv.)
Books (3pcs.)				
Paper inside				
From forest to paper production (n/a-Munkedals, Sweden)	n/a	km	*	
From paper production to harbour (Munkedals-Stockholm)	484	km	Transport, lorry, 16-32t, EURO3.	0,037
From harbour to Latvia (Stockholm-Ventspils)	275	km	Transport, transoceanic freight ship.	0,001
From harbour to storage (Ventspils-Riga)	187	km	Transport, lorry, 16-32t, EURO3.	0,014
From storage to production of books (Riga-Tallinn)	311	km	Transport, lorry, 16-32t, EURO3.	0,024
Cover paper				
From forest to production of paper (n/a-Barcelona)	n/a	km	*	
From paper production to storage (Barcelona-Riga)	3020	km	Transport, lorry, 16-32t, EURO3.	0,020
From storage to production of books (Riga-Tallinn)	311	km	Transport, lorry, 16-32t, EURO3.	0,002
Ribbon				
From forest to production of viscose (n/a-Netherlands)	n/a	km	*	
From viscose to ribbon production (Netherland- Germany)	780	km	Transport, lorry, 16-32t, EURO3.	0,000
From ribbon production to production of books (Sonthofen-Tallin)	2170	km	Transport, lorry, 16-32t, EURO3.	0,000
Cover cardboard				
From forest to production of cardboard (n/a-Netherlands)	n/a	km	*	
From cardboard production to to production of books (Netherlands-Tallin)	2055	km	Transport, lorry, 16-32t, EURO3.	0,093
Books				
From book production to harbour (inside Tallin)	4	km	Transport, lorry, 16-32t, EURO3.	0,001
From harbour to harbour (Tallin-Helsinki)	82	km	Transport, transoceanic freight ship.	0,001
From harbour to office (inside Helsinki)	6	km	Transport, lorry 3.5-7.5t, EURO3.	0,002
Cardboard box				
From forest to cardboard production	n/a	km	*	
From cardboard production to folding to boxes (n/a-Tirol)	n/a	km	*	
From folding to boxes to harbour (Tirol-Tallin)	2215	km	Transport, lorry, 16-32t, EURO3.	0,063
From harbour to harbour (Tallin-Helsinki)	82	km	Transport, transoceanic freight ship.	0,000
From harbour to storage and to office (inside Helsinki)	40	km	Transport, lorry 3.5-7.5t, EURO3.	0,004
Total (kg CO_2 eqv., transportation)				**0,26**
TOTAL (kg CO_2 eqv., product + transportation)				**1,51**

Sources for reference materials/used coefficients:

1) Ecoinvent V3.3. Environmental impact, global warming potential (GWP) 100a.
2) Ecoinvent V2.2. Environmental impact, global warming potential (GWP) 100a.
3) Salonen M., Nissinen, A., Mattinen, M. & Manninen, K. 2016: How is the carbon footprint calcluated in the Ilmastodieetti tool?
4) Airaksinen, M. & Matilainen, P. 2011: A carbon footprint of an office building. Energies 4: 1197-1210.

	Material footprint (kg)	Conservation of old forest (m2)	Carbon Footprint (kg CO2 eqv)	Tree planting (pcs)
Office	11323	226,46	3932	1365,28
Seed	14,63	0,29	2,13	0,74
Books	8,84	0,18	1,51	0,52

Handprint	Material save (kg)	Carbon sequestered (kg)
Seed	485,37	141,87
Books	241,16	70,49

Certificates

Books: FSC-C068125 (FSC Mix)

Cardboard: FSC-C084581 (FSC Mix)

Seed: 80815-2010-AE-FIN-FINAS (PEFC)

More information about the certificated products:

FSC: https://info.fsc.org/

PEFC: https://www.pefc.org/find-certified/certified-certificates

Hand printing partners

Trees for the Future, http://trees.org

The Finnish Natural Heritage Foundation, http://www.luonnonperintosaatio.fi/en

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