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Is sharing caring for the planet? A case study of La Manivelle, a Library of Things in Geneva, Switzerland

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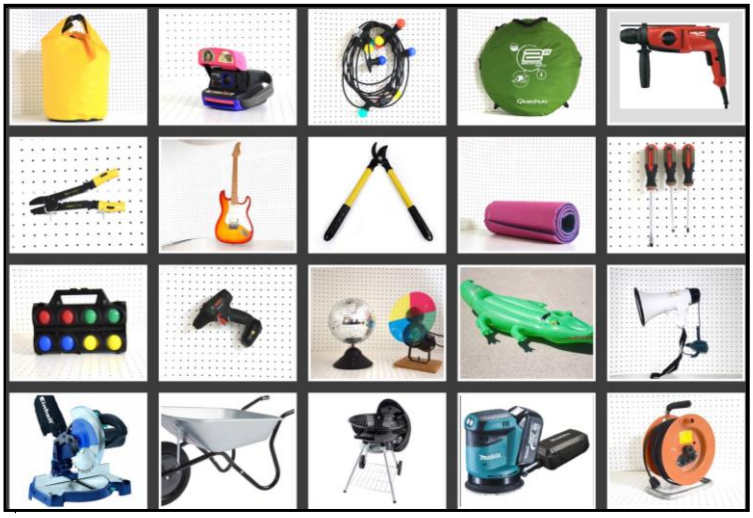

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Abstract

This masters' thesis explores the role of demand-side solutions to current environmental issues by focusing on consumption and the potential role of the sharing economy in alleviating these pressures on the planet. Specifically, this research examines the potential of Libraries of Things (LoT) to promote sustainable consumption and mitigate environmental impacts in the canton of Geneva, Switzerland. The study, undertook in partnership with La Manivelle, a LoT cooperative established in the city of Geneva, investigates how the practice of borrowing infrequently used items from LoTs, rather than purchasing them, can contribute to reducing the associated negative environmental effects of households' consumption, characterised by greenhouse gas emissions, waste and housing space. Utilizing a mixed-methods approach, the study assesses the current environmental impacts of object ownership and explores how these would evolve across different scenarios of item-sharing practices. The research aims to broaden our understanding of the role that LoTs can play in promoting alternative modes of consumption in affluent countries that could contribute to alleviating environmental pressures.

Keywords: sharing economy, Library of Things (LoTs), sustainable consumption, item-sharing.

Résumé

Ce mémoire de master explore le lien entre la consommation et les problèmes environnementaux actuels et le rôle potentiel de l'économie de partage dans l'atténuation de ces pressions sur la planète. Plus précisément, cette recherche étudie le potentiel des bibliothèques d'objets pour promouvoir la consommation durable dans le canton de Genève, en Suisse, en partenariat avec La Manivelle, une bibliothèque d'objets et coopérative établie dans la ville de Genève. L'étude examine comment le partage d'objets peu utilisés auprès de bibliothèques d'objets peut contribuer à la réduction des émissions de gaz à effet de serre et de déchets, et à des économies d'espace pour les ménages genevois. En utilisant une approche mixte, ce travail évalue les impacts environnementaux actuels de la possession d'objets et explore comment ceux-ci pourraient évoluer selon différents scénarios de partage d'objets. Cette recherche vise à élargir notre compréhension du rôle que les bibliothèques peuvent jouer dans la promotion de modes de consommation alternatifs dans les pays riches et contribuer à réduire les pressions environnementales.

Mots-clés: économie du partage, bibliothèque d'objets, économie de la fonctionnalité, consommation durable, partage d'objets.

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Table of Contents

Acknowledgments iv

Table of Contents v

List of Tables viii

List of Figures xi

1 Introduction 1

2 Literature review 3

2.1 The cost of unsustainable consumption patterns 3

2.2 How did we get here? Theories of consumer behaviour 4

2.3 What is the link between consumption and leading a good life? 6

2.4 Historical and theoretical perspectives on sustainable consumption 7

2.5 The sharing economy as a way to promote sustainable consumption 11

2.6 Item-sharing through a *Library of Things* (LoT) 20

3 Research question and case study 27

3.1 Research question 27

3.2 Hypotheses 27

3.3 Case study 28

3.4 Context 29

4 Methods 33

4.1 Background research and interviews 34

4.2 Survey design and promotion 34

4.3 Analysis of the survey's data 38

4.4 Environmental and financial impacts of item-sharing 40

4.4.1 Cradle-to-gate LCA CO_2e of each object and extrapolation to the canton of Geneva 41

4.4.2 Quantity of waste and extrapolation to the canton of Geneva 43

4.4.3 Space saved and extrapolation to the canton of Geneva 44
4.4.4 Scenarios for the canton of Geneva 44
5 Analysis and results of the study 46
5.1 Interview results 46
5.2 The main results of the survey 50
5.2.1 Respondents' socio-demographic information 50
5.2.2 Object possession rate 52
5.2.3 Willingness to borrow 58
5.2.4 The total number of objects needed to fulfil the needs of Geneva households willing to borrow 59
5.2.5 Average frequency of use 61
5.2.6 Household intention, barriers, and motivations to sharing 62
5.3 Estimated environmental impacts of current consumption patterns 63
5.3.1 Estimated GHG emissions 64
5.3.2 Estimated waste 67
5.3.3 Estimated space 69
5.3.4 Potential GHG emissions, waste, and space related to objects that could be affected by item-sharing in the canton of Geneva 70
5.3.5 Scenario comparisons and potential savings 77
6 Hypotheses and answer to the research question 82
6.1 Access over ownership: the potential for households to share seldomly used objects 82
6.2 Potential environmental impacts of object-sharing versus environmental impacts of ownership 83
6.3 Limitations and recommendations for future research 85
7 Conclusion 91
References 94
Appendices 109

Appendix A – Additional detail related to the estimations of objects' carbon emissions.....109
Appendix B - Additional detail related to the estimations of objects' mass.....116
Appendix C - Estimation of the volume of objects.....119
Appendix D – Statistical analysis report (in French).....120
Appendix E – Data tables.....127

List of Tables

Table 1 - Classification of objects according to personal or impersonal..... 39

Table 2 - Respondents' socio-demographic information according to survey results 51

Table 3 - Object possession rate by households in Geneva according to survey results..... 54

Table 4 - Object copies possession rates per household..... 56

Table 5 - Estimation of total number of objects owned by households in the canton of Geneva based on the object possession rate from the survey..... 57

Table 6 - Households' willingness to borrow the six objects in the survey and extrapolated to the population of the canton of Geneva 59

Table 7 - Number of households in the canton of Geneva for whom item-sharing is relevant 60

Table 8 - The number of objects needed to fulfil the needs of households who could potentially participate in item-sharing in the canton of Geneva 60

Table 9 - Average frequency of use per year by households compared to total loans from La Manivelle over a one-year period..... 61

Table 10 - Estimated CO_2e life cycle emissions for the six objects 65

Table 11 - Estimated CO_2e life cycle emissions for the six objects extrapolated to the canton of Geneva..... 66

Table 12 - Estimation of CO_2e for 9 objects for the total households of Geneva 66

Table 13 - Annual estimation of CO_2e for 9 objects for the total households of Geneva 67

Table 14 - Estimated mass of each object and extrapolation to the canton of Geneva 67

Table 15 - Estimation of total mass for 9 objects extrapolated to the canton of Geneva..... 68

Table 16 - Estimation of annual total waste for 9 objects extrapolated to the canton of Geneva. 68

Table 17 – Estimated volume of each object and extrapolation to the canton of Geneva 69

Table 18 - Estimation of total space for 9 objects extrapolated to the canton of Geneva 70

Table 19 - Total tonnes of CO_2e emissions for the six objects compared with tonnes of CO_2e emissions that could potentially be affected by item-sharing 72

Table 20 - Total tonnes of CO_2e that can be affected by item-sharing of 9 objects 72

Table 21 - Tonnes of waste that could be affected by item-sharing for the six objects 73

Table 22 – Tonnes of waste that could be affected by item-sharing for the nine objects 73

Table 23 - Total volume of the six objects that could be affected by item-sharing 74

Table 24 - Total volume of the 9 objects that could be affected by item-sharing 74

Table 25 – Sharing scenario of 1 object per 10 households 75

Table 26 - Summary of results for the sharing scenario of 1 object per 10 households 76

Table 27 – Sharing scenario of one object per 25 households 77

Table 28 - Summary of results for the sharing scenario of 1 object per 25 households 77

Table 29 - Scenario comparisons for CO_2e emissions (tonnes) produced for 9 objects 78

Table 30 - Scenario comparisons for waste (tonnes) produced by 9 objects 78

Table 31 - Scenario comparisons for space (m^3) occupied by 9 objects 79

Table 32 - Comparison between the total annual CO_2e carbon footprint of the Canton of Geneva and the savings in tonnes of CO_2e for the different sharing scenarios 80

Table 33 - Comparison between the total annual municipal waste produced in the Canton of Geneva and the savings in tonnes of waste for the different sharing scenarios 80

Table 34 - Comparison between the total volume of housing in the Canton of Geneva and the savings in space occupied for the different sharing scenarios 80

Table 35 - Comparison between the average volume of housing in the Canton of Geneva and the estimated savings in space occupied by the 9 objects.....81

List of Figures

Figure 1 – A sharing economy platforms typology (Fitzmaurice & Schor, 2015)..... 13

Figure 2 – Greenhouse gas emissions for the canton of Geneva by Category (Service Cantonal du Développement Durable, 2015) 31

Figure 3 - Photographs of the communication campaign to promote the survey..... 36

Figure 4 - Organization chart, La Manivelle, website (2023) 48

Figure 5 - Psychological facilitators to borrowing objects among inhabitants of the canton of Geneva..... 62

Figure 6 - Psychological barriers to borrowing objects among inhabitants of the canton of Geneva..... 63

1 Introduction

In 2022, the Working Group III Contribution to the Intergovernmental Panel on Climate Change (IPCC)'s AR6 report on Climate Change Mitigation devoted a full section to the demand-side of climate action, with a chapter entitled "Demand, Services and the social aspects of mitigation" (Creutzig et al., 2022). This is the first time that the IPCC highlights the key role of demand-side measures in achieving the goal of keeping global temperatures under 1.5 degrees above pre-industrialized levels. The focus on demand-side solutions signals a paradigm shift in the way we think about mitigation. By demonstrating that people do not need energy per se but rather, they seek services to achieve wellbeing, the IPCC report offers new paths for climate action (Westervelt, 2022). It finds global emissions could be highly reduced if policy supports the provisions of low-emission services and lifestyles, all this while improving human wellbeing.

A demand-side approach is not only useful to address the climate crisis, it is also relevant when looking at the other environmental crises we are currently facing. Today, the world is dominated by a capitalist economic model driven by the goal of unlimited economic growth, despite finite natural resources. This worldview has serious consequences for all living beings and endangers the continuity of human life on Earth. On a global scale, we are already living beyond our means: in 2019, humanity overconsumed nature's biological budget by 75% (Wackernagel et al., 2019). Furthermore, humanity is exploiting natural resources at a rate which exceeds the regenerative capacity of the biosphere, resulting in a state of ecological overshoot (Wackernagel et al., 2019). Current environmental problems, ranging from declining biodiversity and ocean acidification to scarcer water resources and increased pollution amongst others, are increasing at an alarming rate and are compounded with a changing climate.

To counter these threats, proponents of sustainable development and green growth advocate for the reduction of environmental externalities associated with economic growth and human activity. But so far, very little evidence supports the possibility of absolute decoupling economic growth from environmental pressures, with scholars arguing that even if it were to occur, it would be insufficient to meet climate targets (Parrique et al., 2019; Wiedmann et al., 2015; Fanning & O'Neill, 2019). Focusing solely on technology to solve these issues is likely to fail and may even delay climate action (McLaren & Markusson, 2020). For example, gains from technological improvements tend to be offset by an increase in wealth and consumerist lifestyles

(Alfredsson et al., 2018). In this light, a growing number of scholars, as part of the post-growth movement, are advancing the idea that unlimited economic growth is not possible on a finite planet. Yet our current economic system relies on the premise of economic growth for its stability (Jackson, 2009). The most apparent solution to this dilemma consists in transforming our current economic model in a way that makes it compatible with ecological limits. This radical transformation entails many aspects, from shifting the way we produce and consume to changing our values and aspirations as human societies.

The following research looks at demand-side solutions to current environmental issues by focusing on consumption patterns and the potential role of the sharing economy, specifically through a Library of Things (LoT), in alleviating these pressures on the planet. Specifically, the focus will be on affluent segments of the population, portrayed in this case by the Swiss population. Researchers have argued affluent classes with high consuming behaviours have key roles to play in mitigating the current environmental crises as well as a historical responsibility to do so, as they are disproportionately responsible for past and current carbon emissions as well as hold higher material footprint and energy use than poorer segments of the population (Alfredsson et al., 2018; Hickel, 2020; Hickel et al., 2022; Wiedmann et al, 2020; Otto et al., 2019).

The first part of this master's thesis consists in a review of the literature relating to current production and consumption patterns and the factors driving them. Next, we will review literature pertaining to consumption alternatives presented under the umbrella of "sustainable consumption", specifically focusing on the sharing economy. The second part of the thesis will present the research questions, the chosen methodology, and the results of the research, followed by a discussion of the results and concluding remarks.

2 Literature review

2.1 The cost of unsustainable consumption patterns

The ecological footprint of affluent populations' current lifestyles has reached unprecedented levels, leading to the overshoot of several planetary boundaries, and bringing ecosystems close to dangerous tipping points. Global resource use, through processes of material extraction, production, consumption, and waste, is in large part responsible for this ecological damage (Hickel et al., 2022). Every year, over 90 billion tonnes of materials, including biomass, metals, fossil fuels and minerals, are consumed at the global scale (Oberle et al., 2018). Environmental impacts of resource use occur at all stages of production, from extracting natural resources to their subsequent processing and transportation (Wiedmann et al., 2015). Resource use is responsible for half of total global greenhouse gas emissions and for 90% of biodiversity loss and water stress (Oberle et al., 2018). If we continue on the current path, global material use is set to more than double by 2060 (Oberle et al., 2018). But not all of humanity is equally responsible for these alarming trends, as high inequalities in resource use exist across nations and within nations (Hickel et al., 2022). The levels of material footprint consumed by the high-income groups are about two thirds higher than those of the upper-middle income group, and thirteen times the level of the low-income groups (Wiedmann et al., 2015).

Furthermore, the environmental impacts of our high-consumerist lifestyles go beyond extraction and production, as they also occur at the level of consumption and disposal. At the household level, a study found that the production and use of household goods and services was responsible for 60% of global greenhouse gas emissions and between 50% and 80% of total land, material, and water use (Ivanova et al., 2016). Higher material consumption also tends to correlate with higher waste disposal, and both trends increase as income levels rise (Chen et al., 2020; OECD, 2019). Combined, high-income countries are generating more than one-third of the world's waste, although they only account for 16% of the global population (Kaza et al., 2018). In turn, poor waste disposal causes environmental problems, by contributing to climate change and air pollution as well as impacting ecosystems and public health (Economy Division, 2021). Recycling, often put forward as the solution to waste, has however shown its limitations in curbing waste and can even lead to increased consumption (Ma et al., 2019).

In addition to creating more waste, higher consumption levels are also correlated with increased living space per person, as the middle and upper classes accumulate possessions, due in part to dynamics of "status-driven consumption" (Fuchs et al., 2021, p.40-41). Increased living space is a trend worth mentioning since housing is a main driver of greenhouse gas emissions, notably because of household heating (Fuchs et al., 2021). Current overconsumption levels have social consequences too: unsustainable lifestyles contribute to greater inequality and conversely, inequality contributes to unsustainable consumption patterns (Wilkinson and Pickett, 2009, cited in Lorek & Vergragt, 2015). For Seyfang (2009), focusing on consumption, as opposed to production, is fundamental because it highlights issues of inequality and inequity that are otherwise invisible. By excluding those who cannot participate in it, consumer culture results in a consumption inequality, where consumption practices uphold the fundamental structures of power and inequality which define our world (Schor, 1999). Finally, Bianchi & Cordella (2023) argue that addressing current unsustainable consumption patterns is key, as circular economy strategies will not be sufficient to curb primary resource extraction, especially in the context of increased global consumption that could outweigh gains made through circularity.

This short review of empirical evidence shows that affluent classes' current consumption patterns are far from being compatible with a finite planet. This raises the question of how these patterns came to be in the first place.

2.2 How did we get here? Theories of consumer behaviour

The issue of overconsumption has been a subject of concern for human societies throughout their existence, with evidence dating back to the 2nd or 3rd century (Jackson, 2014). But it was in 1972, with the publication of The Club of Rome's *Limits to Growth* report, when the link between resource depletion, environmental damage and consumption patterns stemming from rising levels of affluence received widespread attention (Meadows et al., 1972). Since then, researchers from a variety of academic fields have looked at the relationship between consumption and environmental problems by way of different approaches, seeking to understand how and why human consumption became one of the main drivers of environmental degradation. This has led to the emergence of numerous theories of consumer behaviour, notably in the fields of sociology, economics, and psychology.

Seyfang (2009) organises these theories of consumer motivation into three categories: the conventional *utilitarian* approach, the *social-psychological* approach, and the *infrastructures of provision* approach. The utilitarian approach aligns with the principles of neo-classical economics, viewing consumption as a rational behaviour and a means to increase utility for individual consumers. On the other hand, the social and psychological approach views consumption as a response to social contexts and psychological needs. In this second approach, we find the term *conspicuous consumption*, also known as *display consumption*, coined by sociologist Veblen (1994) to depict consumption as a means to advertise status, power and social position, as well Hirsch (1976)'s *positional consumption* which defines *positional goods*, as the items we consume to compare ourselves socially with respect to other people (as cited in Jackson, 2008). Schor (2016) also writes about the *positional treadmill*, which describes the dynamic in which people work hard to keep up with the consumption levels of their peers, for the theory argues a person's wellbeing will depends on relative consumption levels. Ultimately, the social and psychological approach to consumer motivation emphasises the symbolic role of goods, how we use them to communicate our status and our values, and how consumption behaviour is shaped by social pressures instead of rational ones (Seyfang, 2009; Jackson, 2008).

The theoretical approach to consumer motivation that Seyfang (2009) calls infrastructures of provision goes beyond the individual scale to look at collective decision-making and how it is shaped by socio-technical infrastructure, which refers to the "set of infrastructures, technologies and structures which set the rules and parameters within which individual actors may exhibit self-determination" (p.18). This approach highlights the concept of *inconspicuous consumption* which refers to everyday, ordinary consumption which, rather than being about displaying status, is about "convenience, habit, practice, and individual responses to social norms and institutional contents" (Jackson, 2008, p.28). This theory of consumption behaviour embraces a societal perspective, by analysing the systems and infrastructures of provision which "lock-in" individuals into certain consumption patterns and lifestyles practices (Seyfang, 2009). It implies that consumption patterns are constrained by the current systems of provision; creating alternative systems of provision is thus required if we want to change how we consume. Seyfang writes that the most fundamental system of provision governing our consumption behaviours is the mainstream imperative of economic growth. This connects to Jackson's theory of the *engine of growth* (2009) in market

economies, which is driven by two factors. The first, the profit motive, at the basis of our capitalist system, encourages the constant production of new products and services, and the second, which he calls a "complex social logic", pushes consumers to ever-increasing consumption. These two factors—the continual production of novelty by firms and the continual consumption of novelty by households—are self-reinforcing, and combined, keep us locked in an "iron cage of consumerism" (Jackson, 2009, p.100). To free ourselves from this detrimental social logic of consumerism and to develop a new vision of prosperity within ecological and social limits, Jackson (2009) advocates for new kinds of economic structures as well as changes in values, lifestyles, and social structures. The theoretical approaches reviewed here question the very roots of consumerism and instead of portraying consumerism as a natural or inevitable force, acknowledge that it is a socially constructed concept that can be influenced by individuals and society as a whole.

2.3 What is the link between consumption and leading a good life?

Faced with mounting evidence of environmental degradation, questioning the links between economic growth, consumption and wellbeing is crucial. Social critique of the consumer society is not new: Marx, Illich, Bookchin, Fromm and Scitovsky, among others, have expressed their scepticism towards the belief that increased consumerism brings increased satisfaction, and in some cases, have blamed consumerist culture for inciting alienation and social atomisation in modern human society (all cited in Jackson, 2008). Research has to some extent supported these critiques with empirical evidence, with numerous studies looking at tackling the common assumption that increased consumption equals increased wellbeing (Jackson, 2008). Researchers have found that beyond a certain threshold, the relationship between increased material consumption and individual wellbeing disappears and they have widely documented the limitations of Gross Domestic Product (GDP) as a measure of social progress (Lamb & Steinberger, 2017). The Easterlin Paradox, named after Richard Easterlin, refers to the fact that, beyond a certain point, higher income levels do not necessarily lead to higher levels of happiness (Easterlin, 1974). Evidence suggests that some countries with lower levels of consumption per capita actually perform better than others on wellbeing indicators (Roberts et al., 2020). These findings have led to the development of alternative theories and metrics to measure human wellbeing (Lamb & Steinberger, 2017), which distinguish on the one hand, wellbeing, and on the other, affluence, which considers consumption and economic production (Roberts et al., 2020). The research tends to conclude that there are

multiple dimensions to wellbeing and that one metric is rarely sufficient to measure wellbeing, with other factors such as social relationships, health, and personal values that may play a greater role in determining individual wellbeing (Lamb & Steinberger, 2017). One of the most well-known alternative approaches is Max-Neef's needs-based theory, which theorises wellbeing stems from the satisfaction of nine fundamental human needs (Max-Neef et al., 1991). Other scholars have pursued the reflection even further, questioning whether consuming less could actually lead us to live better lives, all the while reducing our impact on the environment, which they've named the *double dividend* in sustainable consumption (Jackson, 2008). For example, recent studies look at how people who participate in grassroots initiatives such as eco-villages and Transition towns involving communal living "manage to reconcile lower carbon footprints and less materialistic living with higher life satisfaction" (Ivanova & Büchs, 2020, p. 2).

What do all these theories have in common? The desire to distinguish wellbeing from consumption, to propel new ways of consumption which are compatible with the limits of the planet. The term "sustainable consumption" has become one of the most well-known ways to define the latter and forms the basis for one of the Sustainable Development Goals (SDGs), SDG 12: "Ensuring sustainable consumption and production." We will now explore how this concept came to be and its various conceptualisations.

2.4 Historical and theoretical perspectives on sustainable consumption

The concept of sustainable consumption gained visibility in the international policy arena at the UN Conference on Environment and Development in Rio de Janeiro in 1992 (Jackson, 2014). Rio's Agenda 21, an action plan product of the summit, dedicated a chapter to 'changing consumption patterns', highlighting the need to curb unsustainable lifestyles among richer societies and redistribute resources at a global scale to meet basic needs in poorer parts of the world (Chappells & Trentmann, 2015). The action plan emphasised material flows and the need for assessments of environmental impacts and resource requirements with life cycle approaches of products and processes (Chappells & Trentmann, 2015). Two years later, the Oslo Symposium on Sustainable Consumption adopted the term, defining it as "the use of goods and services that respond to basic needs and bring a better quality of life, while minimising the use of natural

resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardise the needs of future generations." (Norwegian Ministry of Environment, 1995, first paragraph of section 1.2). Following the symposium, the United Nations Environment Programme made sustainable consumption a focus of national and global sustainability policy through its Sustainable Consumption and Production (SCP) Framework (Jackson, 2014).

At the same time, the concept of sustainable consumption emerged in the academic world. However, as we saw previously, the social sciences approach strongly differed from the SCP paradigm, choosing to question "status and distinction, meanings and communication, systems of provision, power and identity, and social practices" in opposition to SCP policies which "approached consumption in individualistic terms of rational economic choice" (Chappells & Trentmann, 2015, p.55). Since then, within the academic world, the concept of sustainable consumption has inspired various debates and competing perspectives. Seyfang (2009) distinguishes perspectives on sustainable consumption as *mainstream* versus *new economics*. The mainstream view promotes the idea of "consuming differently", using market mechanisms, favouring incremental change, and continued economic growth (Seyfang, 2009). On the other hand, the new economics perspective insists on "consuming less," seeking fundamental regime change, creating new systems and non-market alternatives, and replacing the goal of economic growth with that of wellbeing (Seyfang, 2009). According to this classification, the Oslo Symposium's definition would align with the mainstream perspective of sustainable consumption, because although it mentions consumption that meets basic needs, it does not state the need to reduce absolute levels of consumption, nor does it imply a need to rethink the imperative of economic growth.

On the other hand, the new economics vision of sustainable consumption is radical in that it seeks "system-wide changes in infrastructures of provision" and favours decentralised social and economic organisation as well as local self-reliance to respond to the threats posed by globalisation to the environment and local economies (Seyfang, 2009). This perspective also highlights environmental injustices and inequitable ecological footprints among income classes, emphasising the need for affluent classes to considerably reduce their material consumption. The idea that lifestyle changes in rich countries is of utmost importance with relation to sustainable consumption

is not new. Already in 1987, the Report of the World Commission on Environment and Development entitled *Our Common Future*, also known as the *Brundtland Report*, highlighted the need for those "who are more affluent, to adopt lifestyles within the planet's ecological means - in their use of energy, for example. "(Brundtland, 1987, paragraph 29).

In this literature review, we are most interested in looking at sustainable consumption through the lens of the new economics perspective described by Seyfang (2009). What would this perspective and its central motto asking us to "consume less" actually look like in practice? Various academic fields have sought to map out models where absolute levels of consumption decline yet levels of wellbeing remain steady. The study of degrowth, for example, envisions a deliberate decrease in energy and resource consumption, aimed at restoring a balance between the economy and the environment, while also reducing inequality and enhancing human welfare (Hickel, 2021). Furthermore, many scholars are currently working on specific needs-based models bound by environmental limits to represent what this could look like applied to the world. For example, Raworth's theory of *doughnut economics* seeks to serve as a compass for human prosperity, whose guiding purpose is allowing all people to meet their needs within the planet's limits (Raworth, 2017). The model is composed of two rings, the first representing "a social foundation, to ensure that no one is left falling short on life's essentials", and the second is "an ecological ceiling, to ensure that humanity does not collectively overshoot the planetary boundaries that protect Earth's life-supporting systems." (Doughnut Economics Action Lab, n.d.). The doughnut-shaped space between these two sets of boundaries represents the space that is both ecologically safe and socially just for humanity to flourish. Similarly, the concept of *consumption corridors*, which by defining lower and upper limits to consumption levels, seeks to represent the space where every person can live a good life while keeping "individuals from consuming in quantities or ways that hurt others' chances to do the same" (Fuchs et al., 2021, p.4). The consumption corridor model seeks to enable the pursuits of a good life as well as uphold principles of justice within planetary boundaries (Fuchs et al., 2021).

In addition to studying the driving forces behind consumption and proposing alternative models, researchers have also focused on understanding and developing methods to measure and evaluate the sustainability of consumption. The most common tool is a methodology called the Life

Cycle Assessment (LCA), widely used by businesses, governments, and non-profits, which seeks to measure the environmental impact of a product or service from its design to its disposal (Sonnemann et al., 2018). The relevance of looking at the entire life cycle of a product or service is to prevent local improvements in environmental impact being shifted elsewhere (Jolliet et al., 2016). By quantifying environmental sustainability performance, the LCA is used as a decision-making tool to help identify the most sustainable choices among a series of alternatives (Jolliet et al., 2016). An LCA analysis will typically look at the impact of the product's raw materials, its processing, the transportation involved, the retail, its use and finally its waste management phase (Jolliet et al., 2016).

As mentioned previously, behind these new approaches to consumption lies a paradigm shift, that spans from developing a new understanding of prosperity (Jackson, 2009) to a complete system overhaul. As Vergragt and Lorek (2015, p.19) write "Changing consumption thus entails changing the entire system: it encompasses changing the economic system, the infrastructures, the dominant culture and lifestyles, and changing institutions and power relationships". These alternatives question the "underlying paradigm of materialism and the self-image of nations who are identified as consumer societies" (Elgin, 2013, p.70). The new economics perspective on sustainable consumption puts forward non-market alternatives to consumerism, such as decentralised citizen-led movements, like cooperatives or community-based innovations. For example, communities practising *voluntary simplicity* choose to adopt low-consumption lifestyles in order to increase their quality of life (Elgin, 2013). *Downshifting* (Schor, 1998) describes a similar movement. On the other hand, the *ethical* or *green consumption* movement refers to consuming products which respect certain social or environmental standards (Shaw & Newholm, 2002). Finally, *collaborative consumption*, or otherwise known as the *sharing economy*, describes new forms of consumption that promote access over ownership and has become increasingly popular since the beginning of the 21st century (Botsman & Rogers, 2010). However, although these alternatives to modern consumption seem to imply inherent environmental benefits, the latter have not necessarily been proven.

In particular, a model which has gained visibility in the last decade for its touted sustainability benefits and which we will be focusing on in this research is that of the sharing

economy. The sharing economy refers to a broad range of models, including platforms that provide access to tangible resources, peer-to-peer platforms that provide access to intangible resources (such as knowledge and skills), and platforms that facilitate the resale and exchange of used goods, gifting, swapping, and bartering (Baden et al., 2020). In this thesis, we will explore to what extent the sharing economy may act as a lever to shift society and economic systems away from a culture of consumerism and towards a new economics approach to sustainable consumption.

2.5 The sharing economy as a way to promote sustainable consumption

The terms *sharing economy* or *collaborative consumption* are not easy concepts to define, due to their relative novelty, the diversity of actors who have appropriated them and the wide range of activities they encompass. In this context, the sharing economy has been described as a "buzzword" (Arcidiacono et al., 2018) as well as a "fuzzy" concept (Plewnia & Guenther, 2018). Moreover, the existence of numerous competing terms to designate the sharing economy, such as collaborative consumption or peer economy, has also impeded a clear conceptual understanding of the sharing economy (Plewnia & Guenther, 2018). Scholars have tried to distinguish the overlapping terms (Luri Minami et al., 2021; Benoit et al., 2017), nevertheless they are used interchangeably most of the time. To avoid entangling ourselves in this conceptual confusion, in this paper we will favour using the term sharing economy.

The diverse and unknown potential effects of initiatives identifying themselves as part of the sharing economy have prompted budding public debates, which in turn have led to a rapidly growing body of research focusing on the phenomenon and studying it from different theoretical perspectives (Martin, 2016). Scholars have sought to clarify the conceptualization of the sharing economy, for example by identifying a list of its defining principles (Miguel et al., 2022) or by analysing the different ways in which the sharing economy is framed. For instance, Martin (2016) identifies six contrasting framings, which range from "a potential pathway to sustainability" to "a nightmarish form of neoliberalism".

Before we delve into the literature analysing the various key aspects of the sharing economy, it is important to note that there is nothing fundamentally new or innovative about

sharing — as Belk (2010) reminds us, sharing has been a common form of exchange throughout human history. Scholars argue that what makes the sharing economy distinctive is the fact that it enables the phenomenon of stranger sharing, whereas previously sharing occurred primarily between friends and family (Fitzmaurice & Schor, 2015). These new sharing practices have been made possible with the expansion of digital technologies and the internet's reduced transaction costs between strangers (Frenken & Schor, 2017). Online platforms are key for these types of exchanges since they facilitate sharing by connecting users, offering the possibility to publish reviews, and provide information about the goods and services on offer (Fitzmaurice & Schor, 2015). By offering consistent mechanisms to evaluate user reputations, these platforms offer a way to surmount "the barriers of trust involved in sharing among strangers" (Fitzmaurice & Schor, 2015, p.421).

In this context, Frenken and Schor describe the sharing economy as "consumers granting each other temporary access to under-utilised physical assets (idle capacity), possibly for money" (2017, p.123). Although Belk makes a distinction between the sharing economy and collaborative consumption, he agrees that they share similarities: both the sharing economy and collaborative consumption involve utilizing consumer goods and services through temporary access non-ownership models, and rely on the internet, especially Web 2.0, to facilitate this process (Belk, 2014). The notion of *idle capacity* is central to the definition of the sharing economy since it calls us to distinguish between item-sharing and "on-demand personal services" or "on-demand economy", as well as the "second-hand economy" (Frenken & Schor, 2017). Frenken and Schor (2017) explain this distinction using the examples of a ride-hailing company like Uber and contrasting it with that of a carpooling or hitchhiking platform, both initiatives commonly viewed as part of the sharing economy. In the first case, the consumer creates new capacity when ordering the ride, because the trip would not have occurred if the order had not been made. In the second case, the consumer occupies a seat that would otherwise not have been used as the trip would have occurred anyways. The usage potential of objects when they are not in use is therefore what we refer to as idle capacity. As an example, ride-hailing companies are part of the on-demand economy and not the sharing economy, whereas carpooling companies are examples of ride-sharing and fit within the sharing economy (Frenken & Shor, 2017). The notion of *underutilisation* is also important when looking where home-sharing platforms like Airbnb fit within the sharing economy

debate. Frenken and Shor (2017) illustrate the subtleties of the latter with an example. When a house owner is away or owns a spare bedroom, the unoccupied space is temporarily not utilised and can be thus regarded as temporary idle capacity. On the other hand, if a person "were to buy a second home and rent it out to tourists permanently, that constitutes running a commercial lodging site, such as a B&B or hotel" (Frenken & Schor, 2017, p.5) and this situation no longer would correspond to the sharing economy according to the authors' conceptualisation.

To better conceptualise the sharing economy, Fitzmaurice and Schor (2015) created a typology to classify sharing economy platforms and practices, in which they differentiate market orientation (for-profit or not-for-profit) and organising logics (business-to-peer or peer-to-peer) (Fitzmaurice & Schor, 2015, see figure 1). According to the authors, these characteristics influence the nature of sharing economy platforms and shape how sharing among users takes place (Fitzmaurice & Schor, 2015).

Table 26.2 A sharing economy platforms typology

		Organization	
		Peer-to-peer (P2P)	Business-to-peer (B2P)
Market orientation	Non-profit	P2P Non-profit sharing e.g. food swaps, time banks	B2P Non-profit sharing
	For-profit	P2P For-profit sharing e.g. Relay Rides, AirBnB	B2P For-profit sharing e.g. Zipcar

Figure 1 – A sharing economy platforms typology (Fitzmaurice & Schor, 2015)

The authors argue that platforms will behave differently based on their market orientation. For-profit peer-to-peer platforms earn revenue by charging a commission on the peer-to-peer exchanges they enable. Therefore, to increase their revenue they must increase the number of exchanges occurring on the platform. This differs with business-to-peer platforms which aim to maximise revenue per transaction (Fitzmaurice & Schor, 2015). Similarly, distinguishing sharing economy practices and platforms according to whether they operate as peer-to-peer or business-to-

peer also sheds light on how sharing happens (Fitzmaurice & Schor, 2015). Peer-to-peer consists in individual participants loaning and exchanging their own goods and services, resembling conventional sharing, only that in this case they are strangers (Fitzmaurice & Schor, 2015). On the other hand, business-to-peer exchanges look more like traditional rentals, where individual participants choose what they desire to rent based on their preferences and needs and are subject to rates determined by the owner and availability of the goods or services (Fitzmaurice & Schor, 2015).

Additionally, Fitzmaurice and Schor distinguish four major categories of sharing practices: "recirculation of goods", "exchange of services", "optimising use of assets" and "building social connections." (2015, p. 411). Because the focus of this paper is on sustainable consumption, we will focus primarily on sharing economy practices which focus on the sharing of physical goods. When it comes to physical goods, not all of them are conducive to sharing, which led to the emergence of the concept of the shareable good (Benkler, 2004). The concept refers to goods that by nature provide owners with idle capacity, enabling them to lend or rent them out to other consumers to clear this surplus (Botsman & Rogers, 2010). In practice, not all goods' idle capacity can be easily shared: think of a fridge which is in use all the time or the boots you wear every day. The distinction between durable and consumable goods is also useful: a consumable good is one that has a single use, such as food, or firewood that can only be used once, whereas a durable product can be used repeatedly (Pouri, 2022). Idle capacity of physical goods is commonly illustrated with the example of the power drill, estimated to be used on average between six and thirteen minutes in its lifetime and yet half of US households supposedly own a copy (Botsman & Rogers, 2010). Another statistic put forward by Botsman and Rogers is that in the UK and USA, "80% of the items people own are used less than once a month" (2010, p.83). Therefore, proponents of the sharing economy argue that it is a positive phenomenon for it seeks to "take this idling capacity and redistribute it elsewhere" (Botsman & Rogers, 2010, p. 84).

The idea of focusing on the usage of an object rather than its possession relates to another concept, that of the *functional economy*, from the French "*économie de la fonctionnalité"*. For Vaileanu-Paun and Boutillier (2012), the term refers to moving away from Fordist capitalism based on the production and consumption of goods towards a mode of organisation of production and

consumption based on functionality. More specifically, this means "going beyond the purchase of goods to privilege their temporary availability" (Vaileanu-Paun & Boutillier, 2012, p.3). This shift demands we revisit our relationship to possessions and private property, and could be seen as fitting into other current trends like minimalism (Martin-Woodhead, 2021). In this sense, cultural institutions such as norms and beliefs around access over ownership play a role in the adoption of these new practices (Baden et al, 2020).

Focusing on access rather than ownership is commonly associated with environmental benefits, and especially when it comes to tackling overconsumption from the source (Baden et al., 2020). This is a perception shared by participants of the sharing economy: reducing ecological impact is one of their main motivations for participating, and most platforms play on this motivation by promoting their environmental credentials (Fitzmaurice & Schor, 2015). Prioritising the use of items rather than their possession, optimising their idle capacity and extending their lifespan, are portrayed as the main environmental benefits of sharing, as they could theoretically lead to diminished production of new goods and use of virgin resources (Novel, 2014 as cited in Voytenko Palgan et al., 2017). At the household level, this is backed by evidence that demonstrates that sharing goods within households creates "household economies of scale", with positive social and environmental implications (Ivanova & Büchs, 2020). The authors find that sharing within households can play a role in reducing greenhouse gas emissions and can contribute to meeting climate targets. As a result, researchers have argued for policies and programs that encourage larger household size and sharing within and across households (Ivanova & Büchs, 2020). However, when it comes to practices specific to the sharing economy, studies of how they affect resource intensity and greenhouse gas emissions are few and far between (Fitzmaurice & Schor, 2015). In general, there is very little empirical evidence that supports the claim that the sharing economy contributes to more sustainable consumption (Cohen, 2016; Schor, 2014, as cited in Mont et al., 2020; Harris et al., 2021).

In fact, in some cases the sharing economy has been framed as a "a phenomenon that stimulates consumption and provides access to consuming goods to people who could not afford them before" (Voytenko Palgan et al., 2017, p. 70). Research has highlighted the complexity of the environmental impacts of the sharing economy at a micro and macro-level. Frenken and Schor

(2017) explain that it is important to examine all the ripple effects triggered by a new sharing practice to fully assess its environmental impacts. For instance, on the individual level, if the savings from participating in the sharing economy are used to purchase new goods or participate in unsustainable activities (known as the *rebound effect*), this can reduce or nullify the environmental benefits of the sharing economy (Herring & Sorrel, 2008, as cited in Lorek & Vergragt; Frenken & Schor, 2017). Likewise, the ecological impacts of the sharing economy may seem misleading, since sharing economy platforms contribute to the creation of new markets that "expand the volume of commerce and inject additional purchasing power into the economy" (Fitzmaurice & Schor, 2015, p.414). Therefore, when sharing economy platforms use environmental arguments to promote their activities, they run the risk of greenwashing, since there is oftentimes little basis for their arguments (Demailly & Novel, 2014).

In addition to studying its environmental impacts, researchers have also sought to assess the potential economic and social impacts of the sharing economy. In terms of economic impacts, a study found that collaborative consumption practices can generate financial savings for those involved, leading to an increase in consumer welfare (Frenken & Schor, 2017). Moreover, an investigation around public perceptions of the sharing economy found that positive perceptions were dominant (Cherry & Pidgeon, 2018). The study highlighted the fact that participants believed the sharing economy expands access for lower income households to certain objects previously seen as unaffordable and highlighted increased community cohesion as a key social benefit of sharing (Cherry & Pidgeon, 2018). This is more than a perception: research has shown that some sharing sites have spurred new social ties between people, and that social motivations exist alongside economic motivations (Schor 2015 as cited in Frenken & Schor, 2017; Böcker & Meelen (2017) as cited in Frenken & Schor, 2017).

However, it is not all sunshine and rainbows, as research has also highlighted the existence of negative socio-economic externalities associated with the sharing economy. Research has pointed out that the sharing economy may lead to an increase in economic inequalities, as increased income stemming from the platforms tends to not be distributed evenly among users and between users and the platform (Frenken & Schor, 2017). Indeed, the value generated by sharing economy platforms is generally appropriated by the platform itself, facilitated by the existence of a "tendency

towards natural monopoly and allowing for high margins to be charged by the platform" (Frenken & Schor, 2017, p.7). Secondly, Frenken and Schor (2017) mention the "Piketty-effect of the sharing economy" (p.7): this occurs when owners of valuable assets, who are usually already wealthy, profit disproportionately from these platforms, as the latter enable them to easily turn their "consumer goods into capital assets to earn rents" (, p.7). Other negative externalities of the sharing economy mentioned by Frenken and Schor (2017) consist in peer-to-peer discrimination as well as harming social cohesion. So, while consumer welfare for participants in the sharing economy may increase thanks to reduced prices and more variety, "provider side dynamics" will likely lead to a rise in economic inequality (Frenken & Schor, 2017). Finally, researchers have raised doubts about the viability of non-monetized sharing among people now that sharing economy platforms exist: why share for free when you can share and earn money? (Belk, 2014; Schor, 2015, as cited in Frenken & Schor, 2017).

For most people, the sharing economy is "a more sustainable form of consumption" and a way to critique hyper-consumption, according to Martin (2016, p. 149)'s analysis of how discourses frame the sharing economy. So can the sharing economy create common good, for both people and the planet? What is the sharing economy's potential for social and environmental transformation? Or, as Fitzmaurice and Schor ask, "To what extent can the sharing economy lead to a sustainable and more humane regime of consumption and production?" (2015, p.422). Some scholars go as far as to attach a set of values and norms to the sharing economy in their conceptualization of it: Miguel et al. (2022) claim that one of the founding principles of the sharing economy is that it should "emphasise collective experiences, co-creation and sustainable lifestyles" in opposition to what certain "regime actors" have done by reframing the sharing economy as "purely an economic opportunity" (p. 149). Martin (2016) argues that if sharing economy companies follow the path of corporate co-option, it is unlikely they will contribute to a transition to sustainability. Instead, Miguel et al. (2022) argue that disrupting traditional economic systems ought to be one of the founding principles of the sharing economy.

The degree to which a platform is disruptive to mainstream market models and its potential for expansion is determined by its market orientation, its business model, and the type of service it provides according to Fitzmaurice and Schor (2015). Firstly, the authors illustrate how oftentimes

for-profit platforms, which in many cases start off by emphasising their environmental and social mission, end up favouring profit over their other goals as they develop and mature and become like any old profit-centric business (Fitzmaurice & Schor, 2015). In this light, non-profit social sharing enterprises seem to have a better chance at providing for the common good compared to profit-driven ones. Next, a second criteria highlighted by the authors relates to whether the initiative uses money as a medium of exchange instead of an alternative currency or bartering goods or time (Fitzmaurice & Schor, 2015). Non-monetary dimensions of the sharing economy can be seen as challenging the neoliberal shape of the sharing economy (Laamanen et al., 2018). Fitzmaurice and Schor (2015) argue that platforms promoting trade of used goods or time are more likely to encourage "new economic relations" (p.422). These are therefore the factors, according to Fitzmaurice and Schor (2015), that will determine if an initiative pertaining to the sharing economy, if scaled-up, has "the possibility of creating new economic relations that are more equal, sustainable and socially cohesive." (p.422). On the contrary, if sharing economy initiatives do not fulfil such criteria, the authors suggest they will likely "reproduce existing inequalities, foster high-impact consumer demand, or are likely to converge to business-as-usual if they are successful" (Fitzmaurice & Schor, 2015, p.422). Schor goes as far as to argue that the for-profit platforms are not, in fact, sharing platforms, although they may present themselves as such (Schor, 2015). This connects to Belk's (2014) use of the term pseudo-sharing, which he uses to describe commodity exchanges disguised as sharing "in that they often take on a vocabulary of sharing (e.g., "car sharing"), but are more accurately short-term rental activities" (p.7).

A key issue which has come up in the literature with respect to new sharing economy initiatives is their potential to upscale. It is often assumed that environmentally friendly initiatives ought to be upscaled for their positive impacts to spread. Baden et al. (2020) refer to the concept of *increasing returns to adoption* to explain how, as the use of a service increases, economies of scale can lead to higher financial returns, in turn improving the service, generating more awareness of the service, and making it more attractive to customers. However, the authors present an alternative perspective, whereby there are benefits to remaining small for sharing economy enterprises, as they may function better on a local or regional scale. In addition, Baden et al. (2020) hypothesise that sharing economy initiatives that expand into the mainstream may shift away from their initial values and lose the focus on environmental sustainability as they seek to increase their

customer base and integrate convenience and reduce costs. As mentioned in the previous paragraph, co-optation by corporations is therefore seen as a threat to the social and environmental goals originally promoted by sharing economy initiatives.

Moreover, the fact that the sharing economy is not sustainable by default is put forward in many texts examined in this literature review. Curtis and Mont (2020) argue that the only way for sharing economy initiatives to effectively address the environmental impact of household consumption is if they integrate sustainability within their business model. The authors built a sharing economy business modelling tool, based on a series of pre-conditions, to evaluate and support improved sustainability performance of sharing economy platforms. The four preconditions put forward in Curtis and Mont (2020)'s study are: "1. Operates as a platform; 2. Leverages idling capacity of an existing stock of goods; 3. Possesses non-pecuniary motivation for ownership; and 4. Facilitates temporary access over ownership." (p.6). We will explore these criteria in more detail by applying it to a specific case study in the final section of this literature review.

The impacts of the sharing economy on society and the economy are therefore far from straightforward. The sharing economy is a new, very broad term that encompasses many initiatives that may have very little in common. Although the sharing economy is commonly associated with doing good, we have seen in this brief literature review that scholars do not intrinsically define it as providing automatic environmental or social benefits. Above all, the sharing economy platforms' social and environmental impacts are mostly unknown (Frenken & Schor, 2017; Fitzmaurice & Schor, 2015) and the literature points to gaps in the theoretical and empirical research surrounding its claims of creating "common good" (Frenken & Schor, 2017; Cherry & Pidgeon, 2018; Harris et al., 2021). What we do know is that the sharing economy both solves and creates environmental, economic, and social challenges, with its implementation triggering unintended consequences that may impact wellbeing both positively and negatively (Cherry & Pidgeon, 2018).

2.6 Item-sharing through a *Library of Things* (LoT)

While research on the sharing economy has increased in the past years, a recent review found that many of the studies limited themselves to examining well-known companies like Airbnb and Uber and did not examine the diversity of sharing economy initiatives and their different business models at the community level (Curtis & Mont, 2020). This thesis aims to investigate under-studied sharing economy initiatives, and one in particular that seeks to provide more sustainable ways of accessing resources at the community level: the *Library of Things*, also known as "LoT".

A LoT functions much like a modern book library: members can peruse through an online catalogue, choose which objects they would like to borrow, check their availability, and reserve them prior to picking them up in a physical location. In contrast to peer-to-peer sharing, the LoT operates "as person in charge and guarantor as well as facilitator for the sharing process" of objects (Ameli, 2017, p.4). LoTs are therefore part of the growing movement of enterprises promoting alternatives to ownership, commonly referred to in the literature as *access-based consumption* (Lawson et al., 2016). The objects available in such a library are shareable goods, which as mentioned previously, means they are durable (can be used more than once), but it also means they are suited to one-off use and do not pose any issues with respect to hygiene. The exact number of LoTs around the world is unknown, although a website called Sharestarter.org repertories over 200 around the world (Share Starter – Lending Library Alliance, n.d.). When it comes to the public's perceptions of item-sharing, a 2013 study looked at users' motivations for sharing and found that the top motivations were financial and participation in alternative models of consumption seen as socially and environmentally better (Observatoire de la confiance de la Poste, 2013, as cited in Demailly & Novel, 2014). According to a study on a LoT in Germany, cost savings, convenience and the positive social aspects of sharing were the main motivations of users (Ameli, 2017). People also may avoid buying items that they know they will rarely use and instead, they opt for short-term ownership of items expected to have high idling capacity (Bolton and Alba, 2012).

However, a 2015 study in Germany found that most people surveyed were more willing to share with friends or neighbours than with complete strangers (Verbraucherzentrale, 2015 cited in Schreiner et al., 2018). The example of the German Internet platform "WHY own it" illustrates

how willingness to share is often one-sided, with people more willing to borrow goods than to lend. Indeed, the platform's aim was to facilitate peer-to-peer sharing of objects, much like Airbnb, but it went bankrupt following insufficient use, as not enough people were willing to lend their items (Glöckler, 2015 as cited in Schreiner et al., 2018). The barriers to lending may be: perceived risks, such as risk of damage or loss of one's possessions, or strong attachment to personal items (Schreiner et al., 2018, Philip et al., 2015). LoTs circumvent the challenges posed by peer-to-peer sharing models, since they take on the role of facilitating sharing and caring for the quality and safety of shared goods (Ameli, 2017). In this sense, LoTs may increase the uptake of the practice of item-sharing.

Researchers also put forward these reasons as contributing to the appeal of these types of libraries. They are seen as a more efficient means of providing access to resources compared to individual ownership, by lowering costs, promoting equal access, using fewer finite resources, and freeing space in over-crowded homes (Baden et al., 2020). The assumption is that they enable people to avoid the purchases of a first-hand consumer good, reducing the total numbers of goods in the economy. Moreover, they are seen as leading to a reduction in resource and energy consumption associated with the production and disposal of goods, all while preserving users' quality of life (Ameli, 2017, Frenken, 2017). Furthermore Baden et al., (2020) write of LoTs' potential to improve social ties and autonomy as they "also create a community hub that could also provide resilience by reducing reliance on the conventional financial and supply chain infrastructure." (p.2). The appeal of LoTs is particularly clear in urban areas, which are projected to expand in all countries (United Nations, 2019). For Ameli (2017), the combination of rising urbanisation rates, decreasing purchasing power, and rising rents in a context of scarce resources, raises a challenge for societies, which LoTs hold potential to tackle. Intuitively it appears LoTs can contribute to guaranteeing equal access to basic goods for everyone while limiting the stress on the environment.

Despite the initial advantages for sustainability, there is very little literature dedicated to LoTs (Baden et al., 2020). A study analysing six LoTs in the UK found that all were strongly concerned with sustainability, in terms of their long-term viability as well as in terms of their environmental, economic, and social contributions to the communities they served (Baden et al.,

2020). But out of the six libraries studied, only one had tried to analyse and assess its environmental impact through its own (unpublished) research. As a result, they estimate that their lending and repair services save 11 tonnes of waste from going to landfill and 60 tonnes of CO_2 emissions per year (Baden et al., 2020). Balden et al. (2020) explain that the library measured these numbers using recorded numbers of product repairs and loans as well as standardised measures of resource efficiency of product reuse, however they do not go into more detail with regards to the methods used.

As we have seen in the previous sections, sharing economy platforms are not sustainable by default. Researchers have sought to determine what conditions need to be met by sharing economy platforms in order for them to have a positive environmental impact. In this next part, we will explore their findings and attempt to apply them to LoTs.

As part of their tool to evaluate the environmental sustainability of sharing economy initiatives, Curtis and Mont (2020) put forward four preconditions for improved sustainability performance. The first is that the sharing economy initiative operates as a platform that uses technology to connect resource owners and resource users through a two-sided market. This criterion excludes initiatives that function with a business-to-consumer model, and includes peer-to-peer, business-to-peer and cooperative platforms, for the authors argue they operate as a two-sided market. Two-sided business models are seen as more likely to increase and improve social interaction compared to business-to-consumer models. The authors include cooperatives as two-sided business models because they suggest users take on both the role of resource owner and resource user. The second precondition is that the initiative harnesses the idling capacity of an existing stock of goods. For the authors, this condition is important as it enhances the intensity of usage and extends the lifespan of goods that have already been manufactured but would not be used otherwise, thereby lowering net consumption, and avoiding unnecessary manufacturing of new goods. The third precondition refers to the fact that sharing platforms must not acquire new goods just for the purpose of sharing them, since this "creates an artificial idling capacity of under-utilised assets and reduces material efficiency" with negative environmental effects (Curtis & Mont, 2020, p.7). The idea here is to again exclude business-to-consumer models that function by purchasing new goods with the purpose of sharing them with customers. Finally, the fourth criteria

put forward in the study is that of facilitating temporary access over ownership. This one is self-explanatory: it excludes platforms that are based on the transfer of ownership. The authors argue that "facilitating temporary access is a more efficient allocation of resources by increasing the number of people that have access to one shared resource" in comparison to models that seek to extend product lifetimes by encouraging second-hand purchases or swaps (Curtis & Mont, 2020, p.7).

To complement Curtis and Mont (2020)'s criteria, we can also delve into the conditions put forward by Demailly and Novel (2014) to assess environmental impact, which this time, are specific to item-sharing initiatives within the sharing economy. The first criterion consists in whether item-sharing means the renter avoids buying a product, i.e., the rental replaces a purchase. Second, the renter is provided with a higher quality product, more resistant to intensive use, referring to product durability. The first two criteria imply sustainability benefits because of a reduction in the number of goods in circulation. Third, the rental takes place on a local scale, so travel is minimised and often non-motorized.

I will now explore these three criteria in more detail. The idea of a rental replacing a purchase assumes a reduction in the number of material goods produced. Like with other sharing economy initiatives, the act of item-sharing is perceived as a way to increase the rate of use of material goods, as it enables optimization of the resources used for production, and to contribute to reducing the quantity of material goods to be produced while ensuring the same level of service (Demailly & Novel, 2014). On both a household and a more global level, the assumption is that item-sharing will lead to the production and consumption of fewer objects. This means less materials, energy and less of all the other inputs necessary to the creation and distribution of the objects per se. It also means less space will be needed to store them. This refers to the *optimization effect*, defined by Pouri (2022) as: "The case where sharing optimises the consumption of a resource through enhancing its utilisation. In general, the optimization effect of sharing is based on increasing the lifetime efficiency of a resource—i.e., the total number of functional units delivered per life-cycle-wide resource use of all product/service systems involved in the consumption of a particular resource" (p. 264). Moreover, according to Pouri's analysis (2022), a LoT would produce a *direct optimization effect* which corresponds to "when the number of functional units (as used in

the LCA method) produced by a good and its complementary consumption increases. Optimization might take place across the lifespan of a physical (durable) resource or per service it delivers." (p. 264). Furthermore, a common assumption is that a LoT can contribute even further to a global reduction in the number of goods when the objects being shared are used or second-hand items instead of new ones purchased purposefully for the library. In their study analysing six LoTs in the UK, Baden et al., (2020) found however that this was not always the case. Indeed, the biggest difference between the six LoTs resided in how they sourced the objects in their library. The longest established library, which had initially functioned on a donation-based model, changed strategy to reduce the number of objects and now only offered 70 popular items that were selected and purchased new (Baden et al, 2020). The LoT believed this more focussed strategy enables them to develop a more proactive and sustainable business model. On the other hand, another library sourced most of their objects through donations, which Balden et al (2020) describe as a "more reactive approach to stock management" which meant the library had to proactively solicit donations of items in demand (p.11).

Next, when it comes to product durability, the assumption is that renting reduces the number of goods to be produced only if the borrowed good does not wear out that much faster. The durability of the goods being shared thus becomes a key factor of the environmental sustainability of item-sharing, with *durability* described as "an increase in lifespan but also of their recyclability and the actual recycling carried out." (Demailly & Novel, 2014, p.22). Indeed, durability is an important factor when *the degradation effect*, which refers to "the condition whereby the intensified utilisation of a shared resource leads to its more rapid degradation" is taken into consideration (Pouri, 2022, p. 265).

Finally, reducing the number of goods in circulation comes with another assumption: it ought, in turn, to reduce the transportation of goods, along with its associated negative environmental impacts (Demailly & Novel, 2014). This is important since globally, transportation is a large contributor to climate change: in 2019, transport was responsible for 15% of world total net anthropogenic GHG emissions (IPCC, 2022). In Switzerland, the share of transportation is even higher, representing 41% of CO_2 emissions from energy combustion in 2016 (Thalmann & Vielle, 2019).

This brings us to the third sustainability criteria put forward by Demailly and Novel (2014): the rental minimises transportation since it takes places on a local scale. As mentioned previously, the user's mode of transportation to access the goods is an important factor to take into consideration, since the environmental impact will be lower if soft mobility and higher if a motor-vehicle. Regarding the sustainability impacts of item-sharing and transportation, it is also important to consider the following question: When does the environmental benefit of providing fewer items outweigh the negative effects of an increase in traveling? Behrend (2020) investigates this question by comparing the environmental impacts of a reduced number of items produced with the environmental impacts of the travelling involved in the traditional selling of items and those of item-sharing. They find "that even large differences in transportation can be offset by using fewer items," and explain that this is because emissions generated from energy-intensive stages in the production of items can be significantly higher than those caused by travel (Behrend, 2020, p.13). These findings are useful but case by case assessments assessing the modes of transportation and distance travelled by users of LoTs would be even more useful. We can assume that because of easy access and proximity LoTs are particularly relevant in urban areas, where population density is highest and soft mobility more likely to occur. We can also add that in general, sharing practices are often based on the users' spatial proximity (Demailly & Novel, 2014).

Furthermore, the environmental impact of sharing models cannot be discussed without discussing rebound effects. Indeed, while the shift from buying infrequently used items to borrowing them can provide a reduction in resource consumption, multiple rebound effects are likely to occur as well (Ameli, 2017). Demailly and Novel (2014) distinguish the local rebound effect—when the supposed gain in buying power resulting from sharing is utilised to consume extra units of the shared item or, better said, of the service supplied by this good—with the global rebound effect, when the increase in buying power does not contribute to the increase in consumption of the shared good, but in other sorts of products and services with potentially negative environmental effects. To illustrate this, they write "the money saved through carpooling can be spent on organic products or a trip to the Seychelles." (p.22). However, it is a matter of perspective: when looking at the situation through an environmental lens, one could say the rebound effect has a negative impact. However, if you look at it from an economic and social perspective, one could say sharing can, in some cases, improve access to goods and services for

persons in disadvantaged situations who otherwise would not have been able to afford them (Demailly & Novel, 2014).

The series of conditions and criteria mentioned above do not completely suffice to assess the sustainability of item-sharing, but they have the merit of raising key issues with regards to this new practice. This literature review has shone a light on empirical and theoretical evidence of alternative models of consumption, specifically item-sharing. However, it has identified significant knowledge gaps, especially in relation to the environmental implications of item-sharing. on the rate of equipment usage in households for sharable objects. Additionally, there is limited information on the potential savings in greenhouse gas emissions, household space, or waste reduction that could result from item-sharing if such practices were more widely adopted. In which ways and to what extent can LoTs contribute to sustainable consumption? This question led me to develop the research questions and methodology which I present in the next section.

3 Research question and case study

3.1 Research question

The research question we will be addressing in this thesis is the following: *How can item-sharing, through a Library of Things (LoT), contribute to sustainable consumption?*

Using a case study of a LoT located in the canton of Geneva, Switzerland, the research sub-questions that will guide the research are:

What is the rate of ownership and frequency of use of potentially shareable objects by households in Geneva?

How do environmental impacts of ownership compare to environmental impacts of item-sharing?

What is the potential for reducing environmental pressures on the canton of Geneva if item-sharing were to become widespread?

3.2 Hypotheses

To answer the research questions, I came up with the following hypotheses:

- **The rate of ownership of shareable objects per Geneva household is high compared to the rate of use of the same objects.**

The idea behind this hypothesis is to assess the relevance of item-sharing through a LoT for Geneva households. If Geneva households own few potentially shareable objects, this might mean that they do not need, desire, or use such objects. Likewise, if Geneva households use potentially shareable objects very frequently, once a week for example, this suggests the efforts and capacity required to

borrow objects might outweigh those of purchasing. As seen in the literature review, borrowing objects from LoTs requires many steps, such as checking if the LoT has the object in stock, reserving the object, travelling to and from the location where the objects are stored to borrow and return them. Undertaking all these steps on a weekly basis might simply not be feasible.

- **Geneva households can reduce their environmental impact if they share instead of purchase objects.**

The idea behind this hypothesis is to assess the environmental impact of households' consumption of goods and to compare it to the environmental impact of sharing. Specifically, the environmental impacts that will be measured are GHG emissions, waste and the space occupied by goods in households. This hypothesis can be divided into three sub-hypotheses:

- Geneva households can reduce their consumption related GHG emissions if they share instead of buy objects.

- Geneva households can reduce their waste related consumption if they share instead of buy objects.

- Geneva households can reduce the space occupied by objects in their homes if they share instead of buy objects.

3.3 Case study

This research is the result of a collaboration with an item-sharing LoT cooperative called La Manivelle located in Geneva, Switzerland. Founded in July 2018, La Manivelle's main goal is to provide users with a reliable item-sharing service. It does that by giving its members access to a wide selection of over 3'000 objects stored on its premises, through an online catalogue. The cooperative operates on a membership fee system, and members can borrow objects for periods of up to two weeks at a time.

La Manivelle's mission is to "fight against and raise awareness on rampant consumerism that threatens our environment and perpetuates an unjust economic and social system." (La Manivelle, n.d). La Manivelle aims to reduce social inequalities by increasing accessibility of

objects at a modest price and by adapting its membership costs based on need. Its future plans include developing decentralised versions to serve the greatest number of neighbourhoods and communes in the canton. Ultimately, La Manivelle hopes to convince 10% of the Geneva population to use an item-sharing service. With this goal in mind, La Manivelle has been interested in undertaking research to better understand the environment in which they operate and their current and potential member base to scale up item-sharing in the canton. La Manivelle was also interested in knowing more about their environmental and financial impact as a LoT and the overall potential impact that item-sharing could have if it became a widespread practice in the Canton. It was in this context that the founder and coordinator of La Manivelle Robert Stitelmann, an acquaintance of mine, reached out to me to express their interest in a research project that would look at the environmental savings that could be generated through item-sharing at the level of the canton of Geneva. At the same time, a master's student in psychology at the University of Geneva, Lisa Abiven, was undertaking a research internship at La Manivelle, with the goal of assessing the motivations and barriers towards item-sharing of inhabitants of the canton of Geneva. It was decided that Lisa and I would combine our efforts and collaborate on the different research projects, as I will explain further on in the "Section 4: Methods".

3.4 Context

La Manivelle is located in Switzerland, one of the world's countries with the highest GDP per capita. Material consumption per person is higher in Switzerland than the European average: in 2019, the material footprint per person was 17.1 tonnes in Switzerland, compared to an average of 14.5 tonnes in Europe (OFEV, 2023). Swiss household consumption expenditure is also high in comparison to the rest of the world: when adjusted for inflation, it increased by 27% between 2000 and 2020, outpacing population growth (OFEV, 2023). Food, housing, and mobility are responsible for the greatest environmental damage, with these sectors accounting for almost two-thirds of Switzerland's total impact (OFEV, 2023). Today, Switzerland's consumption and production patterns utilize natural resources beyond the planet's regenerative capacity and limitations. If all countries consumed the same amount as Switzerland, almost three planets would be needed (OFEV, 2023). Since Switzerland imports most of the products and raw materials it consumes, an ever-increasing share of the environmental impact of Swiss final demand takes place outside the country's borders, and currently amounts to two-thirds (OFEV, 2023).

Annually, Switzerland generates an estimated 80-90 million tonnes of waste, and this number is expected to rise in the future. The construction industry is the main contributor to the waste produced (OFEV, 2023). Urban waste, including household, office, and small business waste, as well as waste from yards, gardens and public bins, is the second biggest contributor, accounting for 7% of total waste (OFEV, 2023). This type of waste has been steadily increasing, reaching 6.1 million tonnes in 2020, compared to 1.9 million tonnes in 1970 and 4.7 million tonnes in 2000 (OFEV, 2023). Additionally, the amount of waste produced per person has also risen, from 659 kg in 2000 to 700 kg in 2020, ranking per capita waste in Switzerland among the highest in Europe (OFEV, 2023). When it comes to electronic waste, Switzerland produces 23.4 kg annually per capita and ranks third worldwide (E-Waste Monitor, 2020). In addition to its environmental costs, the disposal of such large quantities has a high financial cost: the annual cost of disposal of all waste in Switzerland amounts to over CHF 3 billion (OFEV, 2023)

Moreover, on average, people living in Switzerland generate around 11.6 tonnes of CO_2 equivalent per person every year for their consumption (Matasci et al., 2021). There are variations among Swiss households when it comes to consumption levels and resulting greenhouse gas emissions. For example, the 10% of Swiss households with the highest greenhouse gas emissions per capita produce between 5 and 17 tonnes of CO_2-equivalent per capita per year more than the lowest 10%, controlling for differences in expenditure level and household structure (Girod & de Haan, 2009). Through consumer behaviour, individuals are not directly able to influence the totality of a country's greenhouse gas emissions; it has been estimated that individuals in Switzerland are able to have a direct influence on about 50% of the greenhouse gas emissions generated by the domestic material consumption of their country (Matasci et al., 2021).

With regards to the canton of Geneva, it was estimated that the canton's carbon footprint amounted to 5'838'207 tCO_2e in 2015, considering all direct and indirect emissions from the activities necessary for living in the canton (Service Cantonal du Développement Durable, 2015). Transport is the main source of CO_2e emissions, amounting to 41% of the Canton's total CO_2e emissions; next comes GHG emissions linked to housing (24%); food and consumer goods come third at 18% (see Figure 2). Based on this figure, consumer goods amount to just over 8% of the total greenhouse gas emissions of the canton of Geneva.

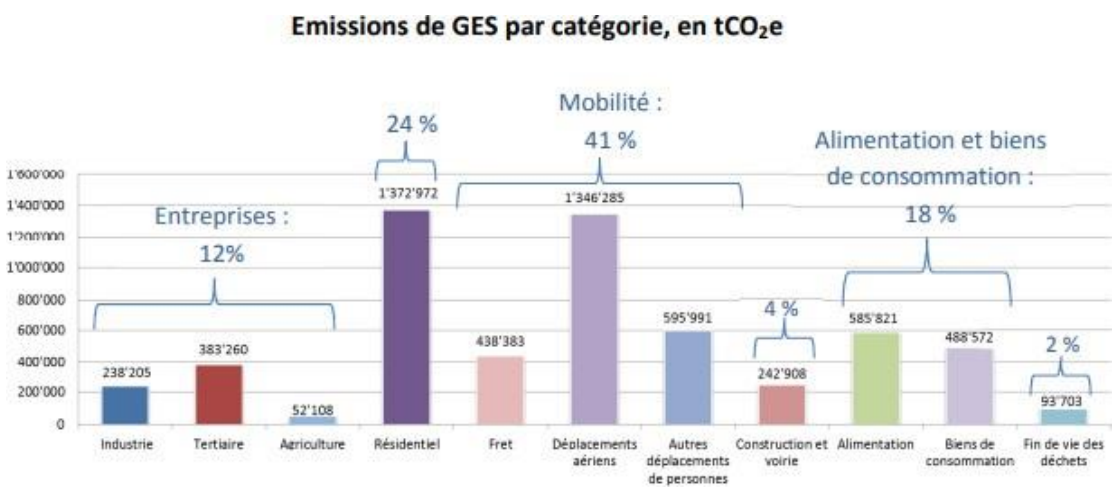

Figure 2 – Greenhouse gas emissions for the canton of Geneva by Category (Service Cantonal du Développement Durable, 2015)

In 2019, it was estimated that the canton produced approximately 568 kg of municipal waste per person per year, of which 355 kg was generated by households (Canton de Genève, 2019). In 2018, 284,200 tonnes of municipal waste were produced in the canton, of which 144,000 tonnes were incinerated and 140,200 tonnes were collected separately (Plan Cantonal de Gestion des Déchets 2020-2025, 2021). To incinerate waste, the canton relies heavily on the incineration plant Cheneviers III, which today incinerates around 250,000 tonnes of waste. However, it is in the process of being destroyed and replaced by a new plant, Cheneviers IV, a smaller, more efficient plant whose capacity will be reduced to 160,000 tonnes of waste. Scheduled for 2025, it will require a 25% reduction in incinerated municipal waste. This is a challenge for the canton but also a way for it to meet its ambitious waste reduction strategy (Plan Cantonal de Gestion des Déchets 2020-2025, 2021).

As the canton is hoping to strongly reduce the amount of waste produced by households, we hope this research can shed light on the potential of item-sharing, through a LoT, to contribute towards that aim. When it comes to households in the canton of Geneva, information on the types and the numbers of objects they own is sparse. Researchers have conducted surveys among households in Switzerland to survey possession of large durable goods for which greenhouse gas emissions amount to more than 300 kg CO_2e, such as dishwashers, cars, or laptops (Girod & de

Haan, 2009). However, I have not found any surveys undertaken for smaller goods, such as those that would typically be on offer in a LoT. Specifically, I did not find any information with regards to the types and quantities of potentially shareable goods owned by households in Switzerland. Additionally, I did not find any studies assessing how environmental impacts of ownership compares to environmental impacts of sharing objects. Therefore, data is currently missing to assess the potential of item-sharing for the canton of Geneva.

4 Methods

To answer the research question and sub-questions, I divided the research into three phases. First, I conducted exploratory interviews with the coordinator of La Manivelle to understand their needs and expectations for the study, as well as the ways in which we would collaborate to achieve the desired outputs. In parallel, I undertook a literature review which included academic and grey literature to better understand the research's context and relevant concepts. Second, in partnership with La Manivelle, I developed a survey whose aim was to estimate the possession rate and frequency of use of shareable objects in households in the canton of Geneva, as well as households' willingness to share such objects.

The objectives were the following:

1) Estimate the rate of possession of potentially shareable objects based on a predefined list of objects for households in Geneva;

2) Estimate the frequency rate of use of potentially shareable objects by households in Geneva and compare it to the annual frequency of use of the same objects at La Manivelle;

3) Estimate the households' willingness to borrow such objects.

A third part of the research—the analysis of the results—took place once the survey had been conducted. The results were analysed with the following objectives in mind:

- Estimate the greenhouse gas (GHG) emissions related to the life cycle of infrequently used objects currently owned by Geneva households, using existing LCA data.
- Estimate the quantity of waste related to the disposal of infrequently used objects currently owned by Geneva households (based on their average mass).
- Estimate the potential space occupied by infrequently used objects in Geneva households (based on objects' average volume)
- Compare the environmental impact of current object ownership with hypothetical scenarios in which objects are shared across households.

4.1 Background research and interviews

In this first phase, I undertook a literature review exploring academic and grey literature sources related to sustainable consumption, the sharing economy and LoTs. In parallel, with the aim of better understanding the case study, I undertook a series of background interviews as well as a formal interview with Robert Stitelmann, the coordinator of La Manivelle. The questions sought to understand certain elements brought up in the literature review with regards to the sustainability potential of a LoT. In particular, I was interested in exploring the business model of La Manivelle and its structure as a cooperative. Next, I sought to explore, using some of the elements from the literature review as guidelines, the sustainability impacts of the objects and the transportation modes used by La Manivelle's members. While it would have been interesting to interview La Manivelle members, this was excluded as it fell outside the scope of the thesis, as I chose to focus on a quantitative analysis.

4.2 Survey design and promotion

The construction of the survey involved various steps. The first step entailed sifting through the list of 100 most borrowed objects of La Manivelle and selecting around 50 of the most borrowed items to be included in the survey. I then classified the objects according to their use, in the following categories: kitchen equipment, tools, outdoor leisure objects and indoor leisure objects. Next, in collaboration with Lisa Abiven, I developed a questionnaire. The first part of the questionnaire focused on socio-demographic variables, which included age, sex, highest level of education achieved, employment, the number of household members and type of dwelling (apartment, house or other). Highest level of education achieved serves as a proxy measure for income, as in Switzerland there is a link between occupational income and an individual's highest level of completed education (Office fédéral de la statistique, 2021). Firstly, these variables were included to assess potential sampling errors and the degree of representativity of the survey's results compared to available statistics from the canton of Geneva. Secondly, these variables may prove relevant with regards to our research question and developing further hypotheses. For example, we can hypothesise the existence of a relationship between a household's income and the number of objects in possession, or between a household's type of dwelling (apartment vs. house) and the number of objects as well as the frequency of object use. Whether a household is a member

of a LoT may also have an influence on the number of objects they own. However, for the purpose of this study we will not go over all the socio-demographic variables in detail as they do not directly relate to our hypotheses. I will focus on the ones that I believe are the most relevant with regards to the research question and hypothesis. Finally, these variables were included in case the survey results were to be used again in the future for further research.

Next, the questionnaire asked respondents if they were aware of the concept of a LoT, and if yes, were they currently or had they been members of one in the past. In addition to providing insights for La Manivelle, this question is also useful to assess the representativity of our sample. For instance, if we were to have had a situation in which there was an overrepresentation of LoT members, this might have biased the results as we can assume that a household that is part of a LoT might own less objects than a household that is not a member of a LoT. The survey included an explanation of the concept of LoTs for those who had no prior knowledge of the concept.

Next, the survey included photos of the selected objects, where respondents were asked to select the different objects they possessed from the list. For each object selected, respondents were asked questions enquiring on their annual frequency of use, the number of copies in possession and the average age of the objects. Respondents were also asked for each object they owned, if they were willing to borrow such an object supposing they did not in fact own their own copy. The question asked for each object was: "If you did not own an XX, would you be willing to borrow it from a LoT?". This question was used to determine the scalability of sharing for different objects.

The last part of the survey consisted of additional questions pertaining to the motivations, barriers and behavioural intention of respondents vis à vis the practice of item-sharing, included by my colleague Lisa Abiven. These questions and their results are not directly linked to my research questions, but I will mention them briefly in the discussion of the results. Finally, at the end of the survey, the participants were asked to consent to their data being shared with La Manivelle and myself for the purpose of this study.

Initially, the questionnaire was tested with six volunteers by telephone who were unaware of the details of the study. These tests were used to finetune the questionnaire. Based on the comments received, some objects were added, others were eliminated, and phrasing was clarified.

For example, we added some objects mentioned by the respondents (sled and crutches) and removed the light garland since respondents emphasised it was used at the same time each year (Christmas). Uncommon objects such as the popcorn machine were taken out. The names of some objects were modified to avoid confusion, and some objects were grouped together following comments by Prof. Julia Steinberger. In total, the survey ended up including 41 objects. Throughout the conception of the survey, concerns about limiting its length to maximise the quality of the answers were taken into consideration. Since the survey remained lengthy, we attempted to make it more respondent-friendly by including photographs of the objects and requiring participants to click on the photographs to indicate which objects they owned.

Once the survey was finalised, it was published on an online survey platform (Qualtrics) and tested repeatedly before being made public. Through funding from the Service de géologie, sols et déchets of the canton of Geneva (GESDEC), La Manivelle organised a public communications campaign between the months of September and November 2022 to promote the survey. The marketing channels used to promote the survey were: flyering during public events, posters in public places, La Manivelle's website, video advertisements in the Geneva tramways, and social media (See Figure 3). To encourage participation in the survey, a free annual membership was offered to whoever filled in the survey until the end.

Figure 3 - Photographs of the communication campaign to promote the survey

Prior to selecting the research methods, I briefly analysed their advantages and disadvantages to select the most appropriate methods while considering their respective limitations. For the sake of brevity, I will only mention a few of these considerations. Online surveys compared to in-person surveys are typically more convenient for participants, allowing participants to respond at their preferred moment as well as take as much time as they require, which may increase response rate (Van Selm & Jankowski, 2006). Online surveys have also been shown to reduce social desirability bias, as participants are less likely to feel the pressure of projecting a positive self-image compared to when they are talking with an interviewer. This can increase the reliability of the results. The cost of online surveys tends to be lower than that of in-person or over the phone surveys, enabling larger samples at a fraction of a cost. On the other hand, weaknesses of online surveys include concerns about privacy issues, propensity to generate errors due to unclear answering instructions as well as sampling biases (Evans & Mathur, 2018). I will particularly stress the last point for it was my biggest concern during this research.

Representativeness of the sample is important to be able to generalise the survey's results. However, online survey methods can lead to sampling biases. It is difficult, "if not impossible" according to Van Selm and Jankowski, (2006, p.439) to guarantee a random sample of respondents when using an online survey because of the ways in which the survey is shared online. The authors affirm that the central issue with online surveys is "the absence of a central registration of users on the Web," which means that, unlike with telephone numbers and home addresses, selecting a random sample from email addresses is impossible. Sampling selection is therefore an issue when it comes to online surveys. Participants tend to be recruited through personal contacts, which undeniably favours a certain type of respondent. For example, La Manivelle shared the survey on their social media channels, which increased the chances of respondents likely to be more engaged in alternative modes of consumption. Offering an incentive — in this case, a free annual membership — was done to increase the response rate of the survey. However, incentives can also lead to the over-representation of a certain demographic or people with certain interests. Here we can think of students or people who were already familiar with the concept of a LoT and who were interested in becoming a member. On the other hand, offering incentives can also encourage hard-to-reach audiences to respond (Evans & Mathur, 2018). In this case, we can hypothesise a free membership could interest people from lower income households. While it would have been

impossible for us to eliminate sampling biases, we did try and mitigate their effects. The survey was also shared in public spaces, using a QR code, in order to target inhabitants of the canton of Geneva and increase the representativeness of the sample. Furthermore, online surveys can also lead to the exclusion of a certain socio-demographic category of respondents, such as people who are not computer literate or connected to the internet. Moreover, the questionnaire demands the respondent answers on behalf of their household: it is therefore entirely possible that the respondent may answer incorrectly inadvertently, while guessing another members' frequency of use for certain objects, for example.

All in all, several sampling biases may have affected the results of the study. However, since the target population of the survey is the population of canton of Geneva, I was able to contrast the socio-demographic results with that of the canton's statistics to estimate which population segments were over or underrepresented in the responses and take this into account in the analysis of the results.

4.3 Analysis of the survey's data

Once the survey closed, my colleague Lisa recuperated the data and, using the software SPSS, produced a detailed report for the survey's results (See Appendix D). From this report, I was able to analyse the results further in relation to my research. The report included the data of respondents who had completed the entirety of the survey and given their consent for the data to be shared with La Manivelle and used as part of this research.

I first examined the socio-demographic data of the respondents, looking at the distribution of gender, age, highest-level of education achieved, employment, and type of dwelling. Next, I classified the objects according to their possession rate among households. This classification enabled the selection of objects deemed relevant for the second part of the analysis. I decided to focus on the six objects with the highest possession rate, because in the context of the research question, it appeared relevant to focus on the objects that had the highest possession rate and therefore hold the highest potential of shareability. I also classified the objects according to whether I considered them "personal" or "impersonal" objects (See Table 1). I used my rationale behind this distinction because I did not find any existing distinction in the literature. The reasoning behind

the personal objects category were objects which implied skin contact or related to food, whereas impersonal objects consisted in everything else.

Personal objects	Sleeping bag / Camping tent / Camping mattress / Raclette machine/ Crepe maker/ Food processor / Ice cream maker / Food dehydrator / Electric fryer / Cheese fondue set / Waffle maker / Panini maker
Impersonal objects	Video projector / Sewing machine / Camera / Pair of crutches / Sledge / Camping stove / Inflatable boat / Bicycle bag / Bicycle trailer / Portable electric stove / Drill-driver / Hammer drill / Jigsaw / Electric winder / Folding step ladder / Electric extension cord / Pair of snowshoes / Jigsaw / Circular saw / Electric winder / Hand truck / Ladder Drill / Mitre saw / Angle grinder / Electric plane / Jigsaw / Circular saw / Electric reel / Shovel dolly / Folding step ladder / Steam cleaner / High pressure cleaner / Hedge trimmer / Big plastic sheet / Portable gazebo / Strimmer / Shovel / Eccentric sander / Angle grinder / Electric hand planer / Mitre saw / Plant Shredder

Table 1 - Classification of objects according to personal or impersonal

Next, I estimated the rate of possession of the six potentially shareable objects by the inhabitants of Geneva and households' willingness to borrow selected objects. I also compared the annual frequency of use of the six potentially shareable objects by the inhabitants of Geneva with the annual frequency of use of the same objects at La Manivelle;

To do so, I created a table (See Appendix E) in which I compared all the different data collected through the survey on those six objects. For each object, this included:

- Possession rate:
    - The possession rate of 1 or more copy of said object per household

    - The possession rate of 2 or more copy of said object per household
    - The possession rate of 3 or more copy of said object per household

- Frequency of use
    - The average annual frequency of use per household (Median)
    - The total annual frequency of use by La Manivelle

- Willingness to borrow
- The average households' willingness to borrow said object

The mean and median are two common ways of measuring average in statistics and they each have advantages and disadvantages. In the case of the survey results, I found that some respondents put down extreme answers which skewed the mean (for example, someone put they used an object 5 times a day) and did not accurately reflect the average frequency of use. That is why I chose to use the Median for the frequency of use.

Next, based on the 2021 number of households in the canton of Geneva (199,994 households), I estimated the quantity of objects in possession by all households in the canton of Geneva if we were to extrapolate the frequency of possession of at least one object to all households (Office cantonal de la statistique, 2022). This gave me the estimated number of the selected objects for the canton of Geneva. It is a conservative estimate since it does not consider the possession rate of households owning 2 or more copies of the same object. Next, based on the data for the willingness to borrow the six objects collected from the survey, I calculated the number of households in the canton of Geneva who would be willing to borrow the six objects.

4.4 Environmental and financial impacts of item-sharing

As a reminder, the objectives of the second part of the research were the following:

- Estimate the GHG emissions related to the life cycle of infrequently used objects currently owned by Geneva households, using existing LCA data.
- Estimate the quantity of waste related to the disposal of infrequently used objects currently owned by Geneva households (based on their average mass).

- Estimate the potential space occupied by infrequently used objects in Geneva households (based on objects' average volume)
- Compare the environmental impact of current object ownership with hypothetical scenarios in which objects are shared across households.

A main point to consider with regards to these estimations are the impacts' different timeframes. The GHG emissions occur at the time of production and distribution of the objects, whereas the waste impact occurs when the object is thrown away. The space impact however takes place every day. As such, for the GHG emissions and waste estimations, we must estimate the average lifespan for each object. For the purpose of the study, I will hypothesise the average lifespan of the objects is 10 years, based on a paper surveying literature on the average lifespans of household appliances (Alejandre et al., 2022). It is important to acknowledge that this number is an estimation. It could have been interesting to include a sensitivity analysis to explore how the results change with different lifespan values, but this was not possible due to time and scope constraints.

I will now explain in detail the different methods I applied to achieve those objectives.

4.4.1 Cradle-to-gate LCA CO_2e of each object and extrapolation to the canton of Geneva

I estimated the environmental impact of each object using the cradle-to-gate life-cycle assessment (LCA) tool. The cradle-to-gate assessment considers impacts at different stages of a product's life cycle, from the time natural resources are extracted from the ground up to the factory gates. This includes natural resources extraction and processing, stages of manufacturing, and all the transportation involved until the product reaches the factory. A cradle-to-gate LCA is different from a cradle-to-grave LCA. A cradle-to-grave LCA is a more comprehensive assessment that includes the entire life cycle of a product or service, while a cradle-to-gate LCA focuses on the environmental impact of the product or service up to the point of production. While the cradle-to-grave LCA divides the product's impact by its total useful life, the cradle-to-gate LCA does not. I chose to focus on the cradle-to-gate LCA to reduce the scope of this research, as it enabled me to omit the use and end of life phase of each object. Cradle-to-gate LCA results only reflect the environmental impacts of the production and distribution stages, and therefore do not account for

the use phase impacts and lifetime variation that come with the usage of the product. The use phase impacts (such as energy consumption, emissions, and resource use) will vary depending on the times a product is used. In this study, I compared the frequency of use of an object owned by a household compared with one being shared in a LoT. In that sense, since I estimated the frequency of use as part of the research, it makes sense to use the cradle-to-gate LCA metric to avoid duplications.

Specifically, I focused on the *carbon dioxide equivalent* (CO_2e). This unit of measurement describes the combined global warming potential (GWP) of different GHG that are commonly recognized as an indicator of human influence on climate change (Eurostat, 2023). CO_2e is used to express the total impact of all greenhouse gases in terms of the equivalent amount of CO_2 and helps to understand the total warming effect of all GHG emissions, instead of just CO_2 alone. It is used to compare the total emissions of different gases and track progress in reducing GHG emissions. I chose this metric for simplicity reasons and because data was readily available.

When possible, I used data from the same database to improve comparability of the results. After researching, the database that I decided to use in priority was the *Base Empreinte*, the official public database for carbon accounting of the French Agency for Ecological Transition (French acronym: ADEME) (ADEME, 2023). I chose this database as it is free to access and contains relevant data for this study. Specifically, its data covers the cradle-to-gate perimeter, is presented for a *consumer sales unit* (in French: Unité de vente consommateur) and is expressed as kilogram of CO_2e per unit or per kilogram (kg CO_2e/kg or kg CO_2e/unit). The *Base Empreinte* database contains cradle-to-gate CO_2e emissions for some objects of the study. So, when available, I used the CO_2e estimations from the *Base Empreinte* database. For objects that were not part of the *Base Empreinte* database and lacked calculated CO_2e estimations, I estimated the CO_2e using data from the database for raw materials whenever possible. In cases where this information was not available in the database, I referred to data from other studies. My estimation was based on the object's main material and average mass. However, it is important to note that in the latter case, the CO_2e estimates may not be comprehensive, as they only represent the extraction and processing of the natural resources. Furthermore, they only reflect the impacts of the main material and exclude the

different components of the object. The result will therefore be a conservative estimate. More details of the methods used for these estimations can be found in Appendix A.

Once I obtained estimates of $kgCO_2e$ for each object, I multiplied these by the number of objects owned by households for the canton of Geneva (according to my previous estimates – see "Section 4.3"). This result gave me the estimated amount of $kgCO_2e$ emitted during the cradle-to-gate life cycle for all the copies of the selected objects in the canton.

4.4.2 Quantity of waste and extrapolation to the canton of Geneva

This was estimated by identifying the average mass of each object. I estimated the latter, when possible, by comparing the masses of three versions of each object from online retailers. I chose the first three stores that appeared on my search browser and searched for similar objects as of the ones currently available for rent at La Manivelle. However, it was not always possible to find a version of the object with the exact same specificities, since the objects of La Manivelle are second-hand and older than what is currently on the market. When the masses were not listed online, I estimated them myself using a scale and my own copy of the object. Once I had the estimated masses per object, I multiplied these by the number of objects I had estimated to be currently in possession by households in the canton of Geneva. This result gave me the estimated amount of weight for all the copies of the objects in the canton. More details of the methods used for these estimations can be found in Appendix B.

It is important to acknowledge that the methods used to estimate the amount of waste is simplified in that it does not consider the amount of waste that is treated, through recycling for example, nor does it include the impact of waste treatment, for example the energy and GHG emissions produced through incineration. Although the metric of "quantity of waste measured by mass of total objects" has its limitations, I believe that it is useful because it improves understanding and visualization of the vast quantity of materials requiring disposal, as well as the resources necessary for their management, regardless of whether they are destined for landfill, recycling, or incineration.

4.4.3 Space saved and extrapolation to the canton of Geneva

This was estimated by identifying the average volume in square cubes (m^3) that each object would take up in a dwelling. To do so, I undertook a standard volume calculation for each object using measurements taken by myself. I added 10% to the estimated volume to account for the estimated storage space needed around the object in dwellings. Once I had the estimates of space occupied by each object, I multiplied these by the number of objects I had previously estimated for the canton of Geneva. This result gives us the estimated volume that would be needed to store all the objects in household dwellings in the canton. More details of the methods used for these estimations can be found in Appendix C.

4.4.4 Scenarios for the canton of Geneva

Once I estimated the GHG emissions, waste, and space for all six objects, I extrapolated and estimated the data for nine objects based on the assumption of a proportional relationship. I chose nine because it is the number of potentially shareable objects owned on average by Geneva households according to the survey results. I acknowledge that it would have been better to analyse the environmental impacts of the nine most possessed objects from the start (instead of just six), but I was unable to do so due to certain limitations that I will explain in the "Section 6.3: Limitations and recommendations for future research".

The goal of this next phase was to estimate the environmental impacts of the potentially shareable objects households own and the subsequent savings that would be possible if households shared those nine objects instead of purchasing them individually. To do so, I compared the estimated environmental impacts of the total estimated objects for the canton of Geneva with that of different sharing scenarios which implied fewer objects. The different sharing scenarios assume that sharing could be promoted by way of several LoTs or other means of item-sharing across the canton of Geneva. Due to the constraints of time and space, I was unable to delve further into the aforementioned assumptions.

With this in mind, the two sharing scenarios that I explored are the following:

- **10 households share 1 object:** how many objects would be needed if 10 households shared 1 object?
- **25 households share 1 object:** how many objects would be needed if 25 households shared 1 object?

The goal was to assess the environmental impacts that could have been avoided if the concept of item-sharing were scaled up to the level of the canton. However, not all objects have the same possibility to be scaled-up, as we saw in the survey and the "willingness to borrow" question. Therefore, using the result from the "willingness to borrow" question and the current possession rates of each object, I estimated how many households in the canton of Geneva own each object and would be willing to borrow said object if they didn't already have their own copy. Here, I assume that all households who own at least one copy of an object have a "need" for said object that would have to fulfilled by item-sharing if the practice were to be scaled-up. These calculations gave me the total number of objects that could be affected by item-sharing if the practice were to be scaled-up.

Next, I estimated how many objects would be required to fulfil households' needs according to the different sharing scenarios exposed above. For each sharing scenario, I estimated their environmental impact, by multiplying the impact of one object with the number of objects necessary to fulfil each scenario.

5 Analysis and results of the study

5.1 Interview results

In this section, I will provide an overview of the main points discussed during the interview with the coordinator of La Manivelle, Robert Stitlemann. I will draw from the literature review to analyse the interview in relation to the problem statement and the research questions.

As seen in the literature review, one of the main features of sharing economy initiatives is that they enable the temporary access of goods over ownership. The literature suggests that, by increasing the number of people that have access to one shared resource, initiatives that facilitate temporary access contribute to a more efficient allocation of resources, increased intensity of use, and a reduction in net consumption. This aligns with La Manivelle's main mission, as explained by Robert during our interview, which is to facilitate access to infrequently used items and reduce the adverse environmental effects of excessive consumption.

In the interview, we discussed the origins of the objects on offer at La Manivelle. Robert told me that the vast majority of objects come from donations. He estimated that around 95% were second-hand donations (donated by members of the cooperative or the general public), while the other 5% are either objects La Manivelle bought new (following requests from members) or new objects donated by firms (Makita donated tools for example). The literature review emphasised the relevance of donation-based models when assessing the sustainability of sharing initiatives. By leveraging the idling capacity of an existing stock of goods, LoTs can play a role in the reemployment of objects that are already in circulation and in turn, reduce the production of new goods.

Robert emphasized the importance of maintaining objects in usable condition as a critical aspect of the project, with one of the primary goals being to extend the lifespan of objects. Initially, the project relied on volunteers for the repair and maintenance of objects, but they have now hired someone part-time (30%) to dedicate themselves to this aspect. Despite their best efforts, Robert mentioned that the reality is that repairing certain objects can cost up to twice as much as purchasing new ones. Finding affordable and suitable replacement parts for repairs is often a challenge, particularly as many objects are not designed with repairability in mind, according to

Robert. Consequently, some objects have had to be disposed of when repairs were not possible or too expensive. However, to prolong the lifespan of donated objects, La Manivelle prioritises high-quality donations. Robert expressed his hope that La Manivelle will be able to increase its financial capacity in the future to invest more in maintenance and repair. With respect to the latter, the literature review highlighted the importance of product durability in assessing the sustainability of an item-sharing initiative, particularly as shared objects are frequently used. Therefore, it is essential for the renter to provide high-quality, durable products that can withstand intensive use.

Next, a major point discussed during the interview concerned La Manivelle's business model and its structure as a non-profit cooperative. Robert explained that the decision to operate as a cooperative was driven by the desire to create an organization that generated economic activity while pursuing a social mission. Additionally, operating as a cooperative opened access to funding opportunities, such as bank loans, which were essential to complement the initial funding of social shares invested by supporters of the project, similar to a crowdfunding process. These supporters, known as "coopérateurs," purchased social shares for CHF 100 each. Initially, borrowing objects from La Manivelle required the borrower to have bought a social share and a yearly membership (between CHF 50 and CHF 100). La Manivelle viewed the social share as a type of guarantee, but after the first year of functioning, they realized that it was not necessary as borrowing had gone well, and the social share was a considerable financial barrier for first-time borrowers. Therefore, they modified the process so that anyone can take out a membership regardless of having a social share in the project. Currently, there are approximately 300 "coopérateurs" compared to around 970 active users of La Manivelle (as of 2022).

As our literature review highlighted, sharing economy platforms' environmental impact is influenced by their market orientation (for-profit vs. non-profit) and business models (peer-to-peer vs. business-to-peer). Research highlighted the fact that non-profit sharing economy initiatives are more likely to produce a positive environmental and social impact compared to for-profit sharing economy initiatives. As opposed to for-profit platforms, whose aim is typically growth or revenue maximisation, non-profits seek to serve needs, usually at a community scale (Schor, 2016). For this reason, La Manivelle's market orientation as a non-profit is relevant with regards to our research question. However, as a cooperative, La Manivelle's business model does not neatly fit into the

peer-to-peer vs. business-to-peer binary often used in the literature. Instead, cooperatives are considered a distinct category that operates as a two-sided market, where members are both resource owners and users (Curtis and Mont, 2020). Cooperatives are also depicted as embodying a democratic governance model, involving users in the decision-making process and being mission driven (Muñoz and Cohen, 2018). At La Manivelle, "coopérateurs" (social share owners) have voting rights in the general assembly and are on equal footing with the Board of Directors (see Figure 4). Cooperatively owned sharing economy platforms, such as La Manivelle, have a greater potential for facilitating environmental and social change compared to corporate platforms due to their inherent nature (Mannan & Pek, 2021).

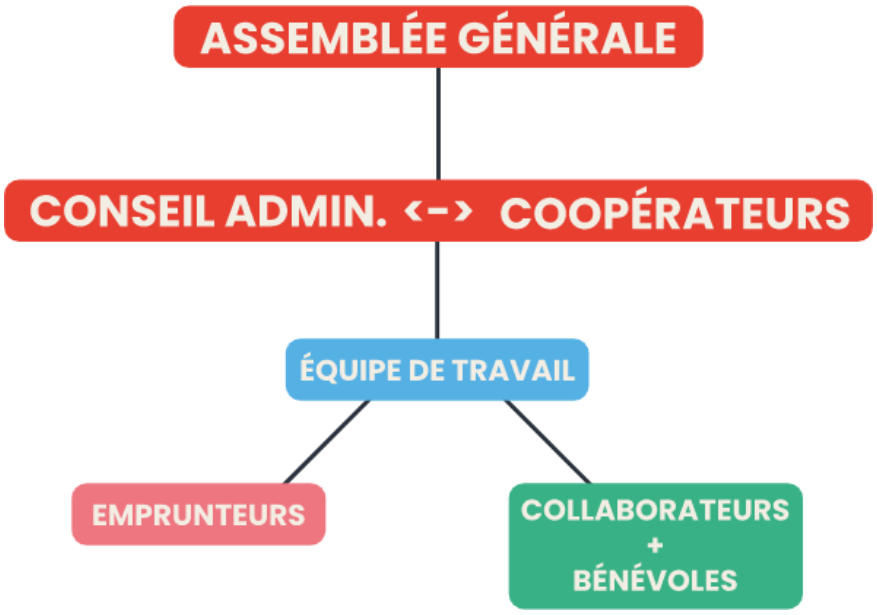

Figure 4 - Organization chart, La Manivelle, website (2023)

During our discussion, we focused on the potential transportation impacts of item-sharing as this was highlighted in our literature review. Local-scale sharing with minimized travel, and the use of non-motorized or shared modes of transportation, can make item-sharing more environmentally sustainable (Demailly & Novel, 2014). In addressing this issue, we examined the location of La Manivelle's library and the various transportation modes available to its members. Presently, La Manivelle's main location, la MACO, is centrally located and easily accessible via

public transport, with bus and tram lines nearby. The library is approximately 2.3km from the main Geneva train station, and La Manivelle has six relay points situated throughout the city for object delivery. According to Robert, members mostly rely on public transport, bicycles, or walking to access La Manivelle. They can borrow the library's cargo bike for larger objects. Although there are no parking spots for motorized vehicles, La Manivelle has a bicycle parking lot in front of its building. According to Robert, this presents a minor inconvenience for members who wish to borrow many items at once or larger objects for an event, which may deter them from borrowing such items. I believe that the low usage of individual motorized transportation modes by La Manivelle members is positive for the assessment of its environmental impact, given the significant contribution of motorized individual transportation modes such as cars to total greenhouse gas emissions.

During the interview, Robert shared his vision for the ideal scenario in item-sharing, aimed at reducing transportation's impact and enhancing accessibility. He suggested that instead of a centralized Library of Things (LoT), many decentralized libraries could be established in each commune or neighbourhood of the canton of Geneva. By bringing the library closer to the users, this could reduce some of the barriers related to convenience and scale up item-sharing practice. Robert also proposed the idea of independent miniature libraries of things at a community level, such as a residential building, where neighbours could pool together their shareable objects. However, this would require scaling up maintenance and organization efforts. Robert acknowledged that coordinating a LoT is not a trivial task, as La Manivelle currently employs several full-time and part-time staff members. Moreover, he emphasized the importance of having clear rules and hygiene protocols in place to ensure the library's smooth functioning and ensure users are comfortable borrowing items.

5.2 The main results of the survey

The survey was live from September 1, 2022, to November 1, 2022. In total, 372 participants from the canton of Geneva completed the survey and gave their consent for their answers to be included in this research. I will now analyse and discuss the results of the survey. Where applicable, I rounded the numbers to three significant digits.

5.2.1 Respondents' socio-demographic information

	Survey respondents	**Canton of Geneva data and respective sources**
Sex/Gender	65.1% identified as women 30.6% identified as men 0.8% identified as other 3.5% chose to not answer	52% women 48% men (Office cantonal de la statistique - OCSTAT, 2021)
Average Age	41 years old Minimum: 18 years old Maximum: 80 years old	40,6 years old (Statistique Vaud, 2022)
Highest level of education achieved	Compulsory school: 3.7% Secondary level: 31% • *Secondary school or professional training* Tertiary level: 65.3% • *Bachelor's degree, Master's degree, PhD or Federal certificate*	Compulsory school: 21% Secondary level: 29% • *Secondary school or professional training* Tertiary level: 50% • *Bachelor's degree, Master's degree, PhD or Federal certificate* Highest level of completed education of the resident population (25-64 years), 2010-2019 (Service de la recherche en éducation, 2022)

Occupation	Employee: 51.1% Student: 12.9% Other: 11.6% Self-employed: 9.9%	Employee: 60% Student: 8% Other: 8% Self-employed: 10%
	AVS/ Pension: 8.9% Unemployed: 5.6%	AVS/ Pension: 5% Unemployed: 9% (OFS / OCSTAT, 2020)
Type of dwelling	Apartment: 80.6% House: 14.8% Other: 4.6%	Dwellings in single-family houses: 11% Dwellings in multi-unit houses (up to 6 units): 6% Dwellings in multi-unit houses (7+ units): 46% Dwellings in other buildings: 37% (OFS, 2022
Average number of people comprising household	Mean: 3.2 Median: 2	2.34 (OFS, 2021)
Knowledge of the concept of LoT	74.4% yes 25.6% no	N/A
Member of a LoT	8.4% yes 86.1% no 4.5% had been a member in the past but were not anymore	N/A

Table 2 - Respondents' socio-demographic information according to survey results

As mentioned in "Section 4: Methods", the respondents' socio-demographic information is useful to assess the representativity of our sample and its results. By comparing these results with official statistics of Switzerland's population, we can evaluate the degree of representativity of the

survey results. That said, it is important to acknowledge that most of the socio-demographic characteristics are only representative of the person who responded to the survey, and not the household in its totality. As such, I will not delve into detail regarding some characteristics of the survey sample, such as respondents' sex and age, which are highly individual characteristics and do not necessarily reveal much about overall household characteristics. On the other hand, I am choosing to explore in more depth two characteristics which I believe are relevant in the context of this study. The first is the over-representation of highly educated respondents and under-representation of respondents whose highest level of completed education is secondary level or compulsory school in our survey sample, compared to the statistics of the canton of Geneva (Service de la recherche en éducation, 2022). As mentioned in the methodology, the highest level of education achieved is a predictor of income in Switzerland, which means that we likely have an over-representativity of high-income groups in our survey relative to the national statistics. There is however a limit to the comparability of the data because whereas only people between 25 and 64 years old are accounted for in the statistics for the canton of Geneva, anyone over the age of 18 years old was allowed to participate in our survey. It also means our data is even more biased towards high-income groups. A second characteristic which I believe is relevant to the object of this research is the type of dwellings. In this regard, our sample appears to be representative of the target population, residents of the canton of Geneva. Survey respondents predominantly reside in apartments (80.6%), and about a seventh reside in houses (14.8%). These results are similar to the statistics of the canton of Geneva, where 11% of households are said to reside in individual houses, which is positive for the representativity of our sample (OFS – Statistique des bâtiments et logements, 2022).

5.2.2 Object possession rate

The report presenting the results shows how many objects Geneva households reported owning from the survey's list. On average, Geneva households reported owning nine objects from the list. In addition, the report shows how many households reported owning at least one copy of the objects as well as households owning multiple copies of each object. Moreover, the report indicated the possession rate among households of each surveyed object among the survey respondents (See Table 3).

Object	№ of households who reported owning at least one of these objects	Household possession rate (%)
Sleeping bag	295	61.1%
Raclette machine	275	56.9%
Fondue kit	286	59.2%
Camera	241	49.9%
Folding step ladder	233	48.2%
Drill-driver	232	48%
Camping tent	183	37.9%
Sewing machine	164	34%
Crepe maker	164	34%
Camping mat	171	35.4%
Electric extension cord	134	27.7%
Pair of crutches	126	26.1%
Food processor	125	25.9%
Panini machine	117	24.2%
Bicycle bags	104	21.5%
Camping stove	87	18%
Shovel/ Pickaxe/ Rake /etc.	87	18%
Pair of snowshoes	86	17.8%
Jig-saw	83	17.2%
Waffle maker	81	16.8%
Sled	81	16.8%
Big plastic sheet	80	16.6%
Video projector	77	15.9%
Inflatable boat	72	14.9%
Portable electric stove	67	13.9%
Hand truck	66	13.7%
Electric fryer	57	11.8%
High pressure cleaner	52	10.8%

Hedge trimmer	49	10.1%
Strimmer	51	10.6%
Steam cleaner	47	9.7%
Hammer drill	44	9.1%
Eccentric sander	41	8.5%
Ice cream maker	39	8.1%
Portable gazebo	35	7.2%
Circular saw	26	5.4%
Food dehydrator	25	5.2%
Bicycle trailer	24	5%
Angle grinder	23	4.8%
Electric hand planer	19	3.9%
Mitre saw	14	2.9%
Plant shredder	11	2.3%

Table 3 - Object possession rate by households in Geneva according to survey results

As mentioned in the methodology section, I chose to analyse the six objects whose possession rates were the highest among households responding to the survey. I chose to focus on objects with the highest possession rate because they have the greatest potential for shareability, which is relevant to the research question.

The selected objects are:

- Sleeping bag
- Raclette machine
- Fondue kit
- Camera
- Folding step ladder
- Drill-driver

The selection of objects for this study is notable for its diversity, as it includes both active and passive objects. For active objects, the use stage represents the largest impact of the life-cycle analysis, while for passive objects, the impact is distributed across all stages except for the use phase (Jolliet et al., 2016). The list of the six selected objects also comprises items of varying sizes, compositions, and materials, as well as electrical products with high and low electronic composition.

For the six objects with the highest possession rate, we looked more closely at how many households owned more than one. The results show that the majority of households own just one copy of each object, except for the sleeping bag, for which most households actually own more than one (See Table 4).

Object	**Copies per household**	**Percentage of households owning the specified № of copies (%)**
Sleeping bag	1	36.7%
	2	39%
	3	9.7%
	4	10%
	More than 4	4.6%
Raclette machine	1	87.6%
	2	10.2%
	More than 2	2.2%
Fondue kit	1	83.9%
	2	12.6%
	More than 2	3.5%
Camera	1	57.9%
	2	28.1%
	3	9.5%

	More than 3	4.5%
Folding step ladder	1	83.7%
	2	12.9%
	3	2.2%
	More than 3	1.1%
Drill-driver	1	91.2%
	2	6.6%
	More than 2	2.2%

Table 4 - Object copies possession rates per household

Few objects were owned by a majority of households. I suggest a few hypotheses to explain this result, mainly related to household characteristics. Indeed, some objects are specific to a certain type of household characteristic, ranging from household composition, household size or type of dwelling. For example, it can be assumed that households living in apartments are less likely to have a garden, which explains why they would not own gardening equipment. Knowing over 80% of respondents live in apartments can, in turn, explain the low rate of possession of gardening tools by respondents of the survey. The same can be presumed about DIY tools: households without a garage or space for a workshop are less likely to own many DIY tools. Next, some of the objects are specific to leisure activities not necessarily practised by a majority of Swiss households, which might explain their low possession rates. Not all households have the same use for all objects. Next, we can hypothesise that households may already be borrowing seldom used objects, but from friends, neighbours, or family, which could explain low possession rates of some objects. Furthermore, the high possession rate of the raclette machine and the fondue kit point to a specific aspect of Swiss culture: these two objects might not have come up with such prominence had this study surveyed populations from neighbouring countries with similar income levels. When considering the number of copies of objects owned by households, it is reasonable to expect variations based on the number of people living in a household, especially for certain items. For

example, the higher number of sleeping bags per household compared to other items could be explained by the fact that they can only be used by one person at a time, and households may use them simultaneously on a family trip for example. However, this observation also raises a concern regarding the potential conflation of individual and household scales in the survey.

Next, I estimated the quantity of objects in possession by all households in the canton of Geneva if we were to extrapolate the frequency of possession of at least one object to all households of the canton (See Table 5). In 2021, there were 199,994 households in the canton of Geneva (Office cantonal de la statistique, 2022).

It is important to note that for the following estimations, I assume that each household which reported possessing an object has only one copy of that object, even though some households may have reported owning more than one copy. Therefore, we can infer that the total number of households that own at least one copy of the objects is equivalent to the total number of objects owned by households in the canton. This assumption will be relevant in "Section 5.2.4: The total number of objects needed to fulfil the needs of Geneva households willing to borrow".

Object	The total № of objects owned by households in the canton based the object possession rate and on the № of households in the canton
Sleeping bag	123,796
Raclette machine	115,397
Fondue kit	120,596
Camera	100,597
Folding step ladder	97,597
Drill-driver	95,997

Table 5 - Estimation of total number of objects owned by households in the canton of Geneva based on the object possession rate from the survey

5.2.3 Willingness to borrow

The respondents were also asked in the survey whether they would be willing to borrow each object surveyed. As mentioned in "Section 4: Methods", this result can shed light on the scalability of sharing depending on the nature of the objects. Furthermore, the analysis of the survey found that there is a significant difference in average borrowing intentions for "personal" compared to "impersonal" items. The statistical analysis, performed by my colleague Lisa, highlighted the following result: personal objects have a lower "willingness to borrow rate" than impersonal objects (See Appendix D). I can offer a few hypotheses to explain the difference in "willingness to borrow" between impersonal and personal objects, such as hygiene concerns or attachment to objects. Moreover, concerns around hygiene and fear of breaking objects were some of the main psychological barriers to sharing, as we will see in "Section 5.2.6."

Next, I focused on the six selected objects with the highest possession rate for the rest of the analysis. The results related to the "willingness to borrow" question show the same thing: not all objects have the same potential to be shared. At one extreme, we have the sleeping bag, which respondents show a considerably lower willingness to borrow (27.8%), and at the other, the drill-driver, with the highest willingness to borrow (81.7%). The rest of the objects have similar percentages, failing on average in the 67% to 72 % range. To estimate the number of households in Geneva willing to borrow each object, I multiplied the percentage by the number of households in the canton of Geneva (See Table 6).

Object	Percentage of households who reported willingness to borrow said object	The № of households in the canton of Geneva willing to borrow said object
Sleeping bag	27.8%	55,598
Raclette machine	72.8%	145,596
Fondue kit	68%	135,996
Camera	67.5%	134,996
Folding step ladder	67.1%	134,196
Drill-driver	81.7%	163,395

Table 6 - Households' willingness to borrow the six objects in the survey and extrapolated to the population of the canton of Geneva

Concerns around hygiene could explain the very low percentage of households who would be willing to borrow a sleeping bag, categorised as a "personal" good, which as we have previously seen, tend to have a lower willingness to borrow percentage. I categorised the raclette machine and fondue kit as personal goods as well, however, their willingness to borrow results are similar to that of the folding step ladder and camera, classified as "impersonal" objects. The drill-driver, on the other hand, is the most expensive object among the six, which could explain why households would be interested in borrowing one.

5.2.4 The total number of objects needed to fulfil the needs of Geneva households willing to borrow

In the previous results, we found that not all households own all objects and not all households are willing to borrow all objects. To estimate the number of households for whom the item-sharing of these six objects would be relevant, I have considered two factors - whether they have a need for the item (indicated by the possession rate) and whether they would be willing to borrow it (indicated by the willingness to borrow). It is important to note that these metrics are approximations. The former metric is guided by the assumption that only households who own an object are assumed to need it, which in reality may not be the case. See Table 7 for the results.

Object	The № of households owning at least one copy of this type of object	The % of households willing to borrow this item	The № of households who need this item and are willing to borrow it
Sleeping bag	123,796	27.8	34,415
Raclette machine	115,397	72.8	84,009
Fondue kit	120,596	68.0	82,006
Camera	100,597	67.5	67,903
Folding step ladder	97,597	67.1	65,488
Drill-driver	95,997	81.7	78,430

Table 7 - Number of households in the canton of Geneva for whom item-sharing is relevant

As explained previously, since I am assuming that each household which reported possessing an object owns at least one copy of that object, we can infer that the total number of households that own at least one copy of the objects is equivalent to the total number of objects owned by households in the canton. Additionally, I am using the object possession rate as an indication of the households' need for the object. Therefore, I was able to estimate the total number of objects needed to fulfil the needs of the households who are willing to borrow each item and as such, participate in the practice of item-sharing (See Table 8).

Object	The total № of objects needed to fulfil the needs of Geneva households willing to borrow
Sleeping bag	34,415
Raclette machine	84,009
Fondue kit	82,006
Camera	67,903
Folding step ladder	65,488
Drill-driver	78,430

Table 8 - The number of objects needed to fulfil the needs of households who could potentially participate in item-sharing in the canton of Geneva

5.2.5 Average frequency of use

Next, the survey inquired about the respondents' average usage frequency per year for each object they owned. The median average annual frequency for all objects surveyed was 5 times per year. Most objects had a frequency of use ranging from 2 to 6 times per year, while some objects, such as bicycle accessories and kitchen items, had much higher frequencies of use. I compared the reported frequency of use of the six objects with the frequency of loans from La Manivelle for the same objects between November 14, 2021, and November 14, 2022 (See Table 9).

Object	**Average use per year (Median)**	**Total loans reported by La Manivelle over a one-year period (14 nov 2021 - 14 nov 2022)**
Sleeping bag	3	67
Raclette machine	6	65
Fondue kit	5	41
Camera	12	48
Folding step ladder	15	50
Drill-driver	10	333
Average (mean) for all 6 objects	**8.5**	**101**

Table 9 - Average frequency of use per year by households compared to total loans from La Manivelle over a one-year period

The study's findings suggest that households in Geneva own numerous objects that they seldom use throughout a given year, with an average frequency of once a month or less, except for the folding step ladder. Although comparing the study results to the annual loans reported from La Manivelle may offer valuable insights, there are a few limitations to consider. Firstly, the numbers from La Manivelle represent the number of times an object was rented out, not the number of times it was used, which could be more than once during the rental period. In contrast, the survey asked respondents to report their average annual use of an object. Secondly, La Manivelle may own multiple copies of an object, which means that the reported annual loans refer to the total loans of each type of object, not individual objects. A major limitation of the current data from La Manivelle

is the absence of information on the number of loans per user. This information is crucial to determine whether sharing libraries encourage greater usage than traditional ownership models, as it reflects the number of uses per user per object.

5.2.6 Household intention, barriers, and motivations to sharing

The results report from Lisa indicated that to the question "Please indicate to what extent you intend to borrow objects from La Manivelle (or other object library)," the average response was 4.03 on a 5-point Likert scale. These results show that among Genevans, the intention to borrow objects from a LoT is relatively high.

Next, the analyses conducted from the survey results revealed the primary psychological facilitators and barriers to participating in item-sharing. Practicality for objects that are rarely used, environmental friendliness, space-saving, and cost-effectiveness were found to be the main facilitators, as depicted in Figure 5. Conversely, logistical challenges, hygiene concerns, relying on borrowing from friends and family, and fear of damaging items were identified as the main barriers, as shown in Figure 6.

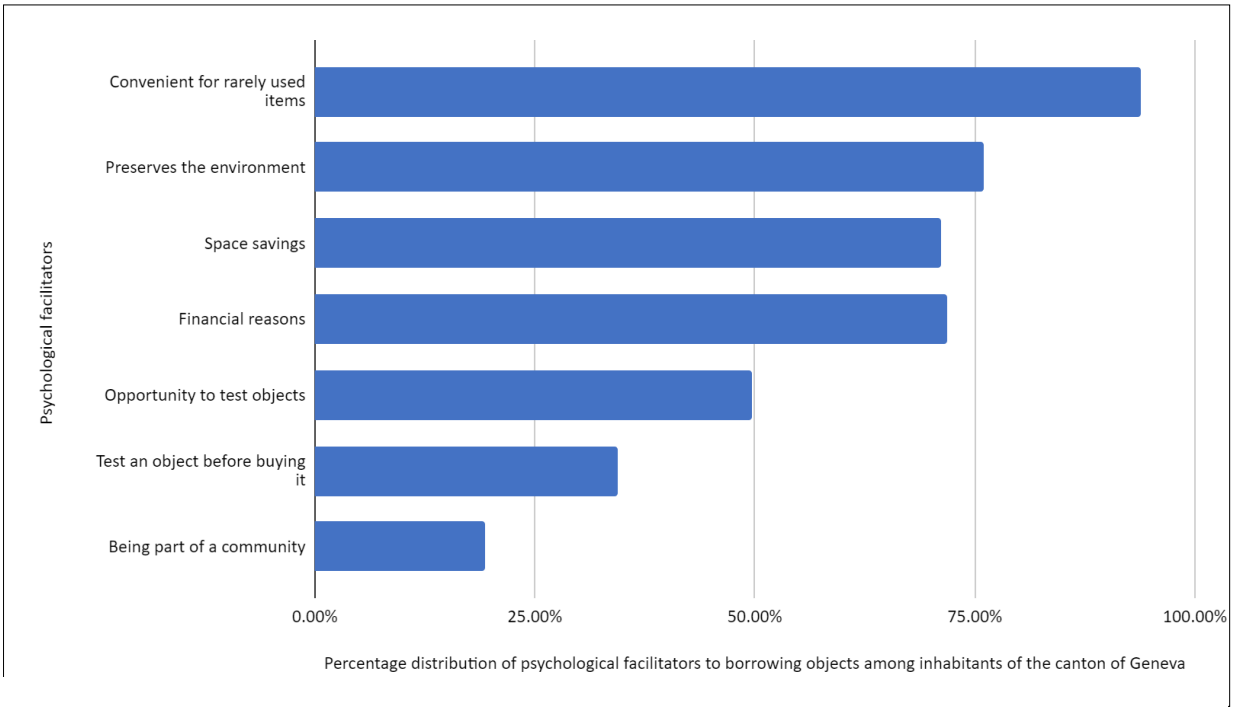

Figure 5 - Psychological facilitators to borrowing objects among inhabitants of the canton of Geneva

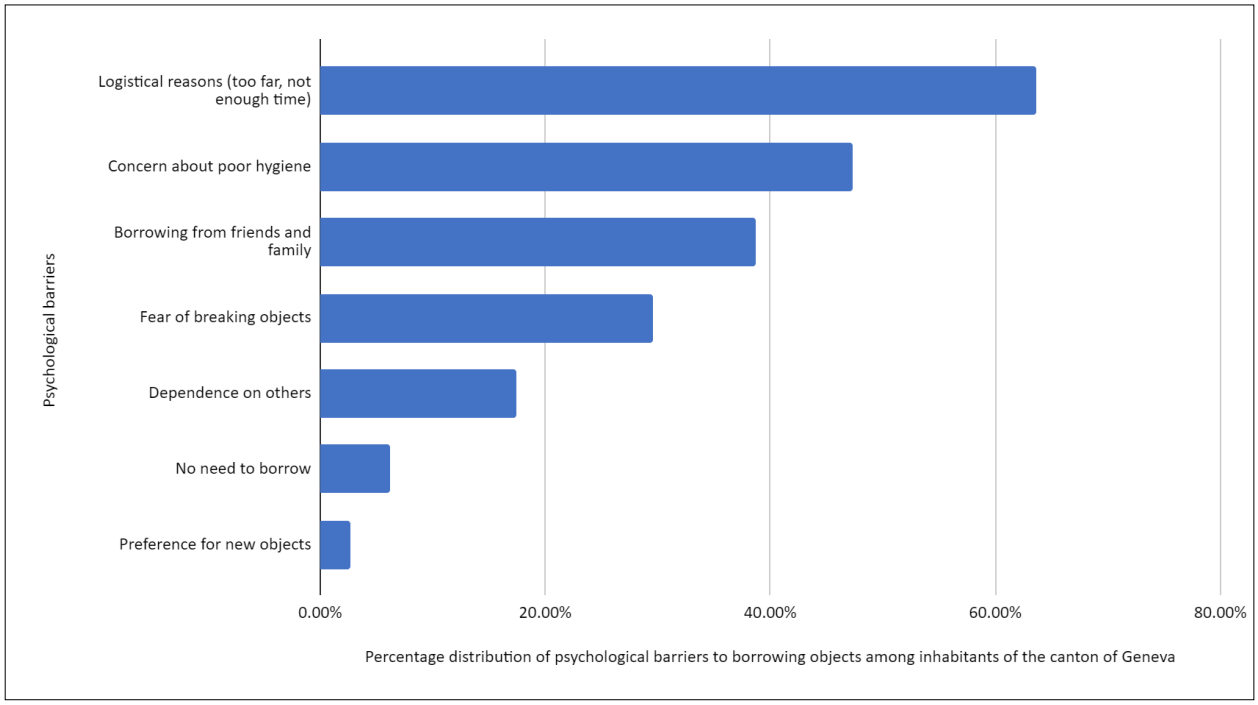

Figure 6 - Psychological barriers to borrowing objects among inhabitants of the canton of Geneva

These findings have important implications for the potential scale-up of item-sharing in the canton of Geneva. In order to increase the adoption of item-sharing, LoTs should prioritize improving convenience, as well as implementing effective hygiene and insurance protocols, and clearly communicating these measures to prospective users. By addressing these psychological barriers and facilitators, LoTs could encourage more individuals to participate in the practice of item-sharing, potentially reducing the environmental impact of consumption patterns and enhancing accessibility to goods.

5.3 Estimated environmental impacts of current consumption patterns

As a reminder, for each of these sections, the idea was to first estimate the lifecycle CO_2e emissions, volume occupied and mass of each of the six objects. Next, I multiplied those numbers by the estimated total number of objects for all households in the canton of Geneva. It is important to note that the impacts for GHG emissions occur at the time of purchase, the space impact is

continual, and the waste impact occurs when the object is disposed of. Using cross-multiplication, I estimated the data for nine shareable objects proportional to the data of the six objects, since nine was the average number of shareable objects owned by Geneva households according to the survey results. It is important to keep in mind that these estimates are based on several assumptions and simplifications and should therefore be treated as rough approximations rather than precise measurements. While they may not be entirely accurate, they provide a useful starting point for understanding the potential impacts of item-sharing on a larger scale.

5.3.1 Estimated GHG emissions

As mentioned in the "Section 4: Methods", I used data from the French Environment and Energy Management Agency (ADEME)'s online database when possible. The database included the CO_2e emissions per unit for three of the objects: the camera, the raclette machine and the drill-driver. For the other three, I estimated the life cycle CO_2e emissions based on data of raw materials from the ADEME's database, when available, and the average mass of the object (See Table 10 and Appendix A for more details).

Object	**kg CO_2e / object (cradle-to-gate)**	**Material assumptions for LCA estimation**	**LCA Source**
Sleeping bag	14.2	100% virgin polyester	My own calculations based on *Base Empreinte*, ADEME, 2023 (See Appendix A)
	6.59	100% recycled polyester	My own calculations based on data from *Base Empreinte*, ADEME, 2023 (See Appendix A)
Raclette machine	16.8	N/A	*Base Empreinte*, ADEME, 2023
Fondue kit	7.34	Cast iron	My own calculations based on data from Zhu et al. (2023) (See Appendix A)

	6.48	Ceramics	My own calculations based on data from Silvestri et al. (2020) (See Appendix A)
Camera	24.4	N/A	*Base Empreinte*, ADEME (2023)
Folding step ladder	31.2	Virgin aluminium	My own calculations based on data from *Base Empreinte*, ADEME, 2023 (See Appendix A)
	2.20	Recycled Aluminium	My own calculations based on data from *Base Empreinte*, ADEME, 2023 (See Appendix A)
Drill-driver	23.5	N/A	*Base Empreinte*, ADEME (2023)

Table 10 - Estimated CO_2e life cycle emissions for the six objects

Using the household possession rates from the survey, I extrapolated the quantities in tonnes of CO_2e for all the six objects for the total number of households of the canton of Geneva (See Table 11). To calculate the average CO_2e emissions for objects which had two estimates based on their material type (i.e., the sleeping bag, fondue kit and folding step ladder) I added up the emissions estimates for each material type and then divided the total by two (the number of material types).

Object	**kg CO_2e / object (based on a cradle-to-gate LCA)**	**Total CO_2e for all object copies in the canton (in tonnes)**
Sleeping bag	14.2	1,758
	6.59	816
Raclette machine	16.8	1,939
Fondue kit	7.34	886
	6.48	781
Camera	24.4	2,450

Folding step ladder	31.2	3,040
	2.20	215
Drill-driver	23.5	2,260
Total CO_2e for 6 objects (in tonnes)		10,400

Table 11 - Estimated CO_2e life cycle emissions for the six objects extrapolated to the canton of Geneva

In Table 11, 10,400 tonnes correspond to the total tonnes of CO_2e emitted for the six objects owned by households in the canton of Geneva, and therefore the estimated quantity of CO_2e emissions generated by the production of these objects.

I then calculated the CO_2e emissions for nine shareable objects on average owned by households in Geneva, using a cross multiplication based on the total for the six objects, the result would be 15,600 tonnes of CO_2e (See Table 12)

Total tonnes of CO_2e for 9 objects (estimations, calculated via cross- multiplication) *Formula: (9 x 10,400) / 6*	15,600

Table 12 - Estimation of CO_2e for 9 objects for the total households of Geneva

It is important to remember the estimated GHG emissions would occur every *X* years when a new object is produced. As mentioned previously, I assumed the average lifespan of the objects to be 10 years, which means I divided the total number by 10. The resulting annual CO_2e for 9 objects would be 1,600 tonnes of CO_2e (See Table 13).

Total annual tonnes of CO_2e for 9 objects (estimations, calculated via cross- multiplication) *Formula: 15,600 / 10 = 1600*	1600

Table 13 - Annual estimation of CO_2e for 9 objects for the total households of Geneva

5.3.2 Estimated waste

I estimated the waste using the average mass of each object from retailer websites as well using my own measurement. More information on how the objects' masses were calculated can be found in Appendix B.

Using the possession rates from the survey, I extrapolated the quantities in tonnes of waste for all the six objects for the total number of households of the canton of Geneva. To calculate the average mass for objects which had two estimates based on their material type (in this case, the fondue kit) I added up the emissions estimates for each material type and then divided the total by two (the number of material types).

Object	**Average mass of 1 unit (kg)**	**The total mass of all objects extrapolated to the whole canton (tonnes)**
Sleeping bag	1.00	124
Raclette machine	4.70	542
Fondue kit	3.35	404
	2.95	355
Camera	0.130	13.1
Folding step ladder	4.00	390
Drill-driver	1.60	154
Total mass of the six objects (in tonnes)		**1,600**

Table 14 - Estimated mass of each object and extrapolation to the canton of Geneva

In Table 14, 1,600 tonnes correspond to the mass of all the 6 objects owned by households in the canton of Geneva, and therefore the estimated quantity of waste generated by these objects when they are disposed of.

I then calculated the total mass of 9 shareable objects on average owned by households in Geneva, using a cross multiplication based on the total for the 6 objects. The result is 2,400 tonnes of waste (See Table 15).

Total tonnes for 9 objects (estimations, calculated via cross-multiplication) *Formula: (9 x 1,600) / 6*	2,400

Table 15 - Estimation of total mass for 9 objects extrapolated to the canton of Geneva

Similarly to the GHG emissions, the estimated waste would occur every X years when a new object is produced. For the purpose of the study, I will hypothesise the average lifespan of the objects is 10 years, which means I will divide the total number by 10 (See Table 16).

Total tonnes for 9 objects (estimations, calculated via cross-multiplication) *Formula: 2,400 / 10 = 240*	240

Table 16 - Estimation of annual total waste for 9 objects extrapolated to the canton of Geneva

The estimated annual waste for the nine objects in question would therefore be approximately 240 tonnes per year. However, it is important to note that the environmental impact of waste is not solely determined by its mass. For example, an object may have a smaller mass but may be made up of components that are difficult to extract, recycle or dispose of, or may be potentially hazardous if not handled properly (such as a camera containing toxic materials). It is therefore important to not over-rely on mass as the sole indicator of a waste's environmental impact. Other factors such as the composition of the waste, the materials used, and the potential

risks associated with it should also be taken into consideration when assessing its environmental impact.

5.3.3 Estimated space

I estimated the space occupied by each object using the average volume of each object identified through my own measurements. More information on how the volumes were calculated can be found in Appendix C.

Using the possession rates from the survey, I extrapolated the volumes of all the six objects for the total number of households of the canton of Geneva (See Table 17). In Table 17, 79,100 m^3 corresponds to the total volume in m^3 continuously occupied by the six objects in Geneva households.

Object	**Average volume (cm^3)**	**Average volume (m^3)**	**Total volume (m^3) of each object extrapolated to the canton**
Sleeping bag	71,600	0.07	8,870
Raclette machine	12,500	0.01	1,440
Fondue kit	14,800	0.02	1,970
Camera	122	0.000100	12.2
Folding step ladder	664,000	0.66	64,800
Drill-driver	20,100	0.02	1,900
Total volume (m^3) for the six objects			**79,100**

Table 17 – Estimated volume of each object and extrapolation to the canton of Geneva

Next, I calculated the total volume of the nine objects, using a cross multiplication based on the total for the six objects. The result is 118,600 m^3 of space occupied by the nine objects (see Table 18).

Total volume (m^3) for nine objects (estimations, calculated via cross-multiplication) *Formula: (9 x 79,100) / 6*	118,600

Table 18 - Estimation of total space for 9 objects extrapolated to the canton of Geneva

While the impact of CO_2e emissions and waste occurs periodically based on the lifespan of an object, the space taken up by the nine objects is a continuous and ongoing issue. By dividing the total volume occupied by these objects by the number of households in Geneva, the average space occupied by the nine objects in a dwelling amounts to approximately $0.5m^3$.

5.3.4 Potential GHG emissions, waste, and space related to objects that could be affected by item-sharing in the canton of Geneva

Now that I have calculated the current emissions, waste, and space scenarios for ownership rates in the canton of Geneva based on the survey results, I can now develop a series of hypotheses to assess how environmental impacts of ownership compare to the environmental impacts of sharing objects. The different sharing scenarios I will explore now suppose the existence of many libraries and/or other means of object-sharing across Geneva households, which as I have mentioned previously, I will not go into further because it falls outside of the scope of this study.

As mentioned in "Section 4: Methods", the two sharing scenarios for which I calculated estimations were:

- **10 households share 1 object**: what CO_2e emissions, space and waste would be produced if 10 households shared 1 object instead of possessing their own copy?
- **25 households share 1 object**: what CO_2e emissions, space and waste would be produced if 25 households shared 1 object instead of possessing their own copy?

The goal is to is to determine the potential environmental benefits of item-sharing if it were, as a practice, to be widely adopted across households in the canton. However, since not all households are willing to share certain objects, the percentage of households that expressed a willingness to borrow each object was used to estimate how many households in the canton would

be open to borrowing each object (see Table 6). By factoring in the "willingness to share" variable, I was able to calculate the potential CO_2e emissions, waste reduction, and volume of items that could be affected by item-sharing. In other words, the potential CO_2e emissions, waste reduction, and volume of items that we have the “power to act upon” through the practice of item-sharing. However, it is important to note that this estimation only considers the current level of willingness to share and is subject to change as attitudes towards item-sharing evolve. If item-sharing becomes more widespread and barriers to sharing are addressed, it is possible that more households will become open to sharing, leading to greater environmental benefits. Therefore, it is important to acknowledge that the estimations made are conservative in that they are based on the current situation and may not fully capture the potential impact of item-sharing if it were to be more widely adopted in the future.

5.3.4.1 Estimation of GHG emissions that can be affected by item-sharing

I found that 6,929 tonnes of CO_2e is the total amount of CO_2e emitted for the six objects most owned by households in the canton of Geneva that could be affected by the scaling-up of item-sharing (See Table 19).

Object	Current scenario for Canton of Geneva (Tonnes of CO_2e)	Household's willingness to share (%)	CO_2e emissions that can be affected by item-sharing (tonnes of CO_2e)
Sleeping bag	1,750	27.8	489
	816		227
Raclette machine	1,930	72.8	1,410
Fondue kit	886	68.0	602
	781		531
Camera	2,450	67.5	1,650
Folding step ladder	3,040	67.5	2,040
	215		144
Drill-driver	2,250	81.7	1,840
Total for the 6 objects	**10,300**	**64.1**	**6,920**

Table 19 - Total tonnes of CO_2e emissions for the six objects compared with tonnes of CO_2e emissions that could potentially be affected by item-sharing

Next, I estimated the CO_2e emissions produced for nine objects owned by households in Geneva, using a cross multiplication based on the total for the six objects (See Table 20**).** I find that 10,300 tonnes of CO_2e is the number of tonnes of CO_2e that could be affected by the practice of item-sharing for nine objects.

Total CO_2e that can be affected by item-sharing, for 9 objects (Estimations, calculated via cross-multiplication) *Formula: (9 x 6,920) / 6*	10,300

Table 20 - Total tonnes of CO_2e that can be affected by item-sharing of 9 objects

5.3.4.2 Estimation of waste that can be affected by item-sharing

I will now do the same for waste. I find that 1,084 tonnes is the amount of waste that could be affected by the item-sharing of six objects (See Table 21).

Object	Amount of waste of Geneva households (in tonnes)	Households' willingness to share (%)	Amount of waste that can be affected by item-sharing (in tonnes)
Sleeping bag	124	27.8	34.4
Raclette machine	542	72.8	395
Fondue kit	404	68.0	275
	355		242
Camera	13.0	67.5	8.83
Folding step ladder	390	67.1	262
Drill-driver	154	81.7	125
Total	**1,600**	**64.1**	**1,080**

Table 21 - Tonnes of waste that could be affected by item-sharing for the six objects

Next, I estimated the waste produced for nine shareable objects owned by households in Geneva, using a cross multiplication based on the total for the six objects (See Table 22). I find that 1,620 tonnes is the amount of waste that could be affected by the practice of item-sharing for nine objects.

Total waste we can act upon for 9 objects (estimations, calculated via cross-multiplication) *Formula: (1080 x 9) /6*	1,620

Table 22 – Tonnes of waste that could be affected by item-sharing for the nine objects

5.3.4.3 Estimation of space that can be affected by item-sharing

I will now do the same for space. I find that 6,247 m³ is the amount of space that could be affected by the item-sharing of six objects (See Table 23).

Object	The volume occupied by these objects in Geneva households	Households' willingness to share (%)	m³ of space that can be affected by item-sharing
Sleeping bag	5,540	27.8	1,540
Raclette machine	1,440	72.8	1,050
Fondue kit	1,970	68.0	1,340
Camera	12.3	67.5	8.28
Folding step ladder	1,080	67.1	726
Drill-driver	1,930	81.7	1,570
Total	**11,980**	**64.1**	**6,240**

Table 23 - Total volume of the six objects that could be affected by item-sharing

Next, I estimated the volume occupied by nine objects owned by households in Geneva, using a cross multiplication based on the total for the six objects (See Table 24**).** I find that 9,360 m³ is the amount of space that could be affected by the practice of item-sharing for nine objects.

Total m³ we can act upon for 9 objects (estimations, calculated via cross-multiplication) *Formula: (6,240 x 9) /6*	9,360

Table 24 - Total volume of the 9 objects that could be affected by item-sharing

5.3.4.4 Item-sharing scenarios

Next, I estimated how many objects would be needed based on the potential number of households for whom item-sharing is relevant (See Table 7) and according to the different sharing

scenarios exposed above. The number of objects needed to fulfil the needs of households who could potentially participate in item-sharing but are not yet participating in the canton of Geneva

For each sharing scenario, I estimated their environmental impact, by multiplying the impact of one object with the number of objects necessary for each scenario.

Scenario: 1 object per 10 household

In this scenario, the assumption is that 10 objects owned by 10 households are replaced by 1 object shared by 10 households.

For this sharing-scenario, I find 693 tons of CO_2e would be emitted, 108 tonnes of waste would be produced, and 625 m^3 of space occupied, for all the six objects (See Table 25).

Object	**The № of objects needed if 10 households share 1 object**	**The total amount of tonnes of CO_2e emitted for this sharing scenario**	**The amount of waste in tonnes for this sharing scenario**	**The amount of space in m^3 for this sharing scenario**
Sleeping bag (virgin polyester)	3,440	48.9	3.44	154
Sleeping bag (recycled polyester)		22.7		
Raclette machine	8,400	141	39.4	105
Fondue kit (cast iron)	8,200	60.2	27.5	134
Fondue kit (ceramic)		53.1	24.1	
Camera	6,790	166	0.88	0.83
Folding step ladder (aluminium)	6,540	204	26.2	72.5
Folding step ladder (recycled aluminium)		14.4		
Drill-driver	7,840	184	12.5	158
Total for the 6 objects	**41,200**	**693**	**108**	**625**

Table 25 – Sharing scenario of 1 object per 10 households

For this sharing-scenario, I find 1039 tons of CO_2e would be emitted, 162 tonnes of waste would be produced, and 937 m^3 of space occupied, for all the nine objects (See Table 26).

	The total amount of tonnes of CO_2e emitted for this sharing scenario *Formula:* *(9 x 693) / 6*	**The amount of waste in tonnes for this sharing scenario** *Formula:* *(9 x 108) / 6*	**The amount of space in m^3 for this sharing scenario** *Formula:* *(9 x 625) / 6*
Total for 9 shareable objects (calculated via cross-multiplication)	1030	162	937

Table 26 - Summary of results for the sharing scenario of 1 object per 10 households

Scenario: 1 object per 25 households

In this scenario, the assumption is that 25 objects owned by 25 households are replaced by 1 object, shared by the 25 households.

For this sharing-scenario, I find 277 tons of CO_2e would be emitted, 43 tonnes of waste would be produced, and 250 m^3 of space would be occupied, for all the six objects (See Table 27).

Object	**The № of objects needed if 25 households share 1 object**	**The total amount of tonnes of CO_2e emitted for this sharing scenario**	**The amount of waste in tonnes for this sharing scenario**	**The amount of space in m^3 for this loan scenario**
Sleeping bag (virgin polyester)	1,370	19.5	1.38	61.6
Sleeping bag (recycled polyester)		9.07		
Raclette machine	3,360	56.4	15.7	42.1
Fondue kit (cast iron)	3,280	24.0	11.0	53.7

Fondue kit (ceramic)		21.2	9.66	
Camera	2,710	66.2	0.35	0.33
Folding step ladder (aluminium)	2,620	81.7	10.4	29.0
Folding step ladder (recycled aluminium)		5.76		
Drill-driver	3,130	73.7	5.02	63.1
Total for the 6 objects	**16,400**	**277**	**43.3**	**250**

Table 27 – Sharing scenario of one object per 25 households

For this sharing-scenario, I find 416 tons of CO_2e would be emitted, 64.5 tonnes of waste would be produced, and 375 m^3 of space would be occupied, for all the nine objects (See Table 28).

	The total amount of tonnes of CO_2e emitted for this sharing scenario *Formula:* *(9 x 277) / 6*	**The amount of waste in tonnes for this sharing scenario** *Formula:* *(9 x 43) / 6*	**The amount of space in m^3 for this loan scenario** *Formula:* *(9 x 250) / 6*
Total for 9 shareable objects (calculated via cross-multiplication)	416	64.5	375

Table 28 - Summary of results for the sharing scenario of 1 object per 25 households

5.3.5 Scenario comparisons and potential savings

Now I will compare the estimations from the sharing-scenarios with the total estimations that could be affected by item-sharing for the nine objects, by environmental impact.

5.3.5.1 Potential CO_2e emissions

	Total CO_2e (in tonnes) that could be affected by item-sharing	**Total CO_2e (in tonnes) produced for the scenario *1 object per 10 households***	**Total CO_2e (in tonnes) produced for the scenario *1 object per 25 households***
Total for 9 objects	10,300	1,030	416

Table 29 - Scenario comparisons for CO_2e emissions (tonnes) produced for 9 objects

In a scenario where 10 households borrow the 9 objects they typically own instead of purchasing their own, this would mean around 9,270 tonnes of CO_2e saved at the time of the production of the objects (10,300 - 1030). If I divide this number by 10 (as a hypothesised lifespan of the objects), the estimated annual savings in tonnes of CO_2e would be around 927 tonnes of CO_2e.

In a scenario where 25 households borrow the 9 shareable objects they typically own instead of purchasing their own, this would mean around 9,880 tonnes of CO_2e saved at the time of the production of the objects (10,300 - 416). If I divide this number by 10 (as a hypothesised lifespan of the objects), the estimated annual savings in tonnes of CO_2e would be around 990 tonnes of CO_2e (rounded to three significant digits).

5.3.5.2 Potential waste savings

	Total waste (in tonnes) that could be affected by item-sharing	**Total waste (in tonnes) produced for the scenario *1 object per 10 households***	**Total waste (in tonnes) produced for the scenario *1 object per 25 households***
Total for 9 shareable objects	1,620	162	64.5

Table 30 - Scenario comparisons for waste (tonnes) produced by 9 objects

In a scenario where 10 households share the 9 shareable objects instead of purchasing their own, this would mean that around 1,460 tonnes of waste could be saved at the time of disposal (1,620 - 162). If I divide this number by 10 (as a hypothesised lifespan of the objects), the estimated annual savings in tonnes of waste would be around 146 tonnes (rounded to three significant digits).

In a scenario where 25 households share the 9 shareable objects they typically own instead of purchasing their own, this would mean that around 1,550 tonnes of waste could be saved at the time of disposal (1,620 – 64.5). If I divide this number by 10 (as a hypothesised lifespan of the objects), the estimated annual savings in tonnes of waste would be around 155 tonnes (rounded to three significant digits).

5.3.5.3 Potential savings in m^3

	Total space (in m^3) that could be affected by item-sharing	**Total space (in m^3) occupied for the scenario *1 object per 10 households***	**Total space (in m^3) occupied for the scenario *1 object per 25 households***
Total for 9 shareable objects	9,370	937	375

Table 31 - Scenario comparisons for space (m^3) occupied by 9 objects

In a scenario where 10 households share the 9 shareable objects instead of purchasing their own, this would mean that around 8,430 m^3 of space typically occupied by these objects in people's households could be continually saved (9,370 - 937), rounded to three significant digits.

In a scenario where 25 households share the 9 shareable objects they typically own instead of purchasing their own, this would mean that around 8,990 m^3 of space typically occupied by these objects in people's households could be continually saved (9,370 - 375), rounded to three significant digits.

5.3.5.4 Summary and comparisons with data from the canton of Geneva

The results show that there is a minor difference in the environmental impacts between the two different scenarios, whether they be 1 object for 10 households or 1 object for 25 households.

However, compared to the total numbers of the Canton, the savings between each scenario do not appear very significant (see Table 32, Table 33, and Table 34).

Canton of Geneva annual total carbon footprint (Service Cantonal du Développement Durable (SCDD), 2015)	**Annual estimated CO_2e savings for a scenario of 1 object per 10 households (in tonnes of CO_2e)**	**Annual estimated CO_2e savings for a scenario of 1 object per 25 households (in tonnes of CO_2e)**
5,838,207	927	990

Table 32 - Comparison between the total annual CO_2e carbon footprint of the Canton of Geneva and the savings in tonnes of CO_2e for the different sharing scenarios

Canton of Geneva annual municipal waste in tonnes (Canton de Genève, 2019)	**Annual estimated savings of waste for a scenario of 1 object per 10 households (in tonnes)**	**Annual estimated savings of waste for a scenario of 1 object per 25 households (in tonnes)**
284,000	146	155

Table 33 - Comparison between the total annual municipal waste produced in the Canton of Geneva and the savings in tonnes of waste for the different sharing scenarios

Canton of Geneva total volume of housing (m^3)	Estimated savings in volume of space occupied for a scenario of 1 object per 10 households (m^3)	Estimated savings in volume of space occupied for a of 1 object per 25 households (m^3)
49,844,058	8,430	8,990

Table 34 - Comparison between the total volume of housing in the Canton of Geneva and the savings in space occupied for the different sharing scenarios

The average living area of dwellings in the Canton of Geneva is 85,6m2 (Office fédéral de la statistique, 2022). I estimated that the average volume is 205 m^3 using a ceiling height of 2.4m which is the standard ceiling height in the canton) (see Table 35).

Average volume of housing in the Canton of Geneva (m^3)	Estimated average space occupied by the 9 objects in a dwelling (m^3)
205	0.5

Table 35 - Comparison between the average volume of housing in the Canton of Geneva and the estimated savings in space occupied by the 9 objects

6 Hypotheses and answer to the research question

Considering the data collected and its analysis, I will now revert to the original research questions and the hypotheses that were initially put forward as potential answers. I will conclude this section with an overview of the limitations of the research, where I will discuss the weaknesses of the study's design and findings. I will also make recommendations for future areas of research that could be conducted related to the study.

As a reminder, the research questions were:

How can item-sharing, through a Library of Things (LoT), contribute to sustainable consumption?

- *What is the rate of ownership and frequency of use of potentially shareable objects by households in Geneva?*
- *How do environmental impacts of ownership compare to environmental impacts of item-sharing?*
- *What is the potential for reducing environmental pressures on the canton of Geneva if item-sharing were to become widespread?*

6.1 Access over ownership: the potential for households to share seldomly used objects

The first hypothesis was:

- **The rate of ownership of shareable objects per Geneva household is high compared to the rate of use of the same objects.**

The idea behind this hypothesis was to assess the relevance of item-sharing for Geneva households. I sought to test this hypothesis by using the results of the survey asking households to report the types of objects they owned, as well as the average annual frequency of use of these same objects. When extrapolating the results of the survey to the canton of Geneva, I found that households in Geneva own several objects that they report using infrequently throughout the year.

Specifically, I found that there are only around six objects that a majority (around 50%) of households own. The rest of the objects are only owned by a smaller proportion of Geneva households, proportion that ranges from 2.3% to 37.9% of households. We can question why not all households own such objects: is it because they do not have the need or desire to use or own them? Or would they like to own or use them but do not have the financial means or space in their homes to do so? Without the answer to these questions, it is difficult to hypothesise on the potential role a LoT could play in relation to fulfilling households' needs of said objects. What we do know is that a LoT has a role to play to increase access to objects that are used infrequently and thus have a higher potential to be shared. When it comes to the frequency of use reported, on average the objects were used 5 times per year. Specifically for the six objects, I estimated that on average they were used around 8.5 times per year per household. I found objects in La Manivelle are used around 12 times as much as those owned by households, although we are missing the rate of use per Manivelle user. In conclusion, I can confirm the hypothesis for the six objects studied: the survey results showed that around half of households reported owning six objects which they used on average less than once a month throughout a given year. Since their possession rates are high yet their frequency of use is low, these objects appear to be the ones who have the most potential to be shared among many households.

6.2 Potential environmental impacts of object-sharing versus environmental impacts of ownership

The analysis of the survey results highlighted how item-sharing could lead to a reduction in environmental impacts at the household level in the canton of Geneva compared to individual possession of the same objects. The assumption is that sharing increases the use-intensity of existing goods and as such, can lead to a reduction in the production of goods, avoiding the associated environmental impacts. Or said differently, the idea is that with more people using one object, the same level of demand can be met with a lesser quantity of goods. I compared the environmental impacts of current ownership with different sharing scenarios to illustrate the impacts that could be avoided if the practice of item-sharing were scaled up. The calculations considered the fact that not all households were willing to share all types of objects. Considering the "willingness to share" variable means that there is only a certain amount of tonnes of CO_2e, tonnes of waste or square cubes of space on which we can act upon. However, it is important to

note that the proportion of people willing to share is not a static number. It has the potential to increase as barriers to sharing are removed and social spreading dynamics occur. In this context, the main hypothesis put forward was that Geneva households can reduce their environmental impact if they share instead of purchase objects. This hypothesis was divided into three sub-hypothesis, which I will now analyse in more detail.

- **Geneva households can reduce their consumption related GHG emissions if they share instead of purchase objects.**

I estimated the combined life cycle CO_2e emissions of the potentially shareable objects owned by households in the canton of Geneva. I compared these CO_2e estimations with the CO_2e emissions of different hypothetical sharing scenarios which assume a reduction in the number of objects produced. The results of the study show that the canton of Geneva could reduce its annual CO_2e emissions by 935 tonnes or 997 tonnes depending on the two sharing scenarios analysed. This is not insignificant; however, it pales in comparison to the canton's overall annual carbon footprint. This is not surprising, as the main sources of GHG emissions for the canton of Geneva, depicted in Figure 2, are transportation, housing, and food. Moreover, the GHG emissions of consumer goods represent just over 8% of the total CO_2e emissions of the canton.

- **Geneva households can reduce their waste if they share instead of purchase objects.**

I estimated the potential waste of the shareable objects owned by households in the canton of Geneva. The assumption being that item-sharing could limit the number of objects produced and in turn, this would result in less objects going to landfill. The results show that the canton of Geneva could reduce its annual household waste by 146 or 156 tonnes depending on the sharing scenarios if we assumed an average object lifespan of 10 years. Similarly to the CO_2e savings described previously, these numbers represent only a small share of the canton's total annual household waste. In 2018, the canton disposed of 284,200 tonnes of municipal waste.

- **Geneva households can reduce the space in their homes if they share instead of purchase objects.**

I estimated the space being occupied by shareable objects in households in the canton of Geneva and compared that estimation with those of two sharing scenarios. I found that homes could free up 0.5m³ space on average if they borrowed the nine objects instead of owning them. At the level of the canton, the total combined space that could be saved is 8,398m³ or 8,996m³ for the different sharing scenarios. Freeing up space is important as housing has a big environmental impact. But like for CO_2e and waste, the potential space saved pales in comparison to that of total homes in the canton of Geneva. I estimated the total volume of dwellings in the canton to be around 49,844,058 m³, while the average volume of dwellings in the canton of Geneva is around 205 m³.

To conclude, I can confirm all three sub-hypotheses, as well as the main hypothesis; the practice of item-sharing can in theory enable households to reduce their GHG emissions, waste, and dwelling size. However, it's important to note that these environmental savings are small compared with the total environmental footprint of the canton of Geneva. As mentioned previously, this is not surprising, since the main environmental pressures of the Canton are not due to household consumption. Nevertheless, as I will develop in the next section, shifting from ownership to access-based consumption may have wider implications for sustainability. Behavioural changes can act as a catalyst for other, more impactful, activities or support wider societal transformations (Capstick et al, 2014). Sharing implies a transformation in our modes of consumption and questions the culture of consumerism and humans' relationship to material things. And sharing through a LoT, especially one that is built around a non-profit cooperative model, offers a local and community-oriented way of accessing services, all while circumventing traditional consumerism culture. According to Seyfang (2009), initiatives that support community-building and collective action are key for promoting new forms of ecological citizenship that involve individuals taking responsibility for the environmental impacts of their behaviour as well as engaging in broader political action.

6.3 Limitations and recommendations for future research

In this section, I will reflect on several limitations of the research design and factors to be considered when interpreting the results. I will also highlight avenues for future research.

In designing my research methodology, I chose to pursue a quantitative approach for two main reasons. The first reason was that La Manivelle expressed a preference for quantitative data

to measure their impact and communicate this information to current and prospective funders as well as members. It was important for me to be responsive to their needs to maximise the research's practical implications. Secondly, I was personally interested in acquiring new skills and expanding my research capabilities. I saw this master's thesis as an opportunity to learn how to conduct quantitative research, as it was an area that I had not previously explored.

However, there were some disadvantages to choosing to focus primarily on quantitative methods, which I will highlight throughout this section. Firstly, since the survey relies on self-reported data, the data collected may not be completely reliable. Respondents may have reported the types of objects they own incorrectly or might have under-reported or over-reported the frequency of use, especially since the survey required respondents to respond for all the members of their household. It is likely that respondents answered the survey without prior validation from the members of their household, and as such some survey responses may be inaccurate. The lack of reliable data ought to be considered when interpreting the findings.

Furthermore, the survey design itself could have been improved and additional questions could have been included. For example, the survey asked respondents who previously owned an object about their willingness to borrow it from a LoT, but it would have been equally relevant to ask those who do not currently own the object if they would be interested in borrowing it from a LoT. Likewise, the analysis of the results show that the categories of "impersonal" vs "personal" objects do not fully explain the different rates of "willingness to borrow" between objects, as some objects classified as "personal" have similar 'willingness to borrow" rates as others classified as "impersonal". It would be interesting to explore in more depth what factors influence a household's willingness to borrow; further research could examine a scale of attachment depending on the types of objects. Nevertheless, the survey did provide insights related to the latter with the questions on psychological barriers and facilitators to sharing, both of which have implications for the question of scaling-up of LoT. The study's results suggest that improving convenience as well as as communication of hygiene and insurance protocols are crucial to promote item-sharing and build trust among users and LoTs. Additionally, the study highlights the need for cultural change and the establishment of new social norms around item-sharing, particularly in populations with heterogeneous norms. Further research could delve deeper into these aspects.

Moreover, the findings also highlight the important role of coordination and maintenance of a LoT, work that is not to be underestimated and which could be explored in further research to improve understanding of the resources needed to run a successful LoT. Furthermore, some respondents cited sharing infrequently used items with family and friends as a reason for not wanting to use a LoT. This raises an important question that has been explored by academics studying the sharing economy: to what extent can institutionalized sharing replace existing sharing practices among friends and family, and is this desirable? This question merits further investigation, as its answer could have significant environmental and social implications. If our goal is to extend the practice of item-sharing to more people, institutionalized sharing should complement rather than replace existing sharing practices among friends and families.

The survey results analysis has some limitations, mainly due to my lack of knowledge of statistical analysis, which resulted in me relying on my colleague Lisa for data analysis. This limitation led to a smaller quantity of analysed data. For example, respondents were asked to report the average age of their objects or how many copies they owned of each object. Yet because of the aforementioned limitations, this data was not analysed. Therefore, the results assume respondents own just one copy when in fact many reported owning more than one copy per object type. Next, my limited knowledge of statistical data analysis combined with communication issues meant that I discovered after completing the environmental impact analysis of the six most commonly possessed objects, that households own an average of nine potentially shareable objects. If I had known this earlier, I would have included the analysis of the environmental impacts of the nine most owned objects from the beginning.

The research also has limitations when it comes to the estimations of the environmental impact of consumer goods versus those of item-sharing. The reader must consider that the environmental impact estimates are conservative for numerous reasons. First, I was only able to find an existing LCA estimation for three of the objects. I had to estimate the LCA for the other three using existing data. Since my knowledge on LCA methods was very limited, I focused on keeping it simple by multiplying the mass of the object by the CO_2e of the main material. This is in no way a complete LCA, as it only includes the materials phase, and excludes all the other phases of an LCA. Next, for the objects with existing LCA, these LCAs only covered the cradle-to-gate

perimeter, which excludes the use phase. Yet, for active objects, the phase use can sometimes have the biggest impact in the LCA. Why? Because the relative importance of the other life cycle phases depends on the total useful life of the products: the longer the total duration of use, the lower the impacts of the other phases. The use phase of an equipment becomes crucial when it is shared among several users because the impacts of other life cycle phases, such as production and disposal, are spread over a larger number of users. Furthermore, the impact of the use phase is directly proportional to the number of times the equipment is utilized. Hence, if an object has a low usage frequency, increasing its usage frequency can lower its overall impact. The fact that I did not include an analysis of the use phase within the LCAs is therefore a limitation which must be considered when interpreting the results. An avenue to be explored for future research could consist in undertaking a longitudinal comparative LCA study of a consumer good used by one household compared with that of one belonging to a LoT.

Similarly, it is important to note that the results are highly speculative and assume that savings can be achieved in the canton of Geneva by decreasing the production and disposal of objects. In reality the estimated number of objects already exist in the current economy and will at some point have to be discarded — ending up in landfills or at best, recycled. Yet, the research makes it appear as if the savings could happen overnight, when in fact they would occur progressively over time as people adopt new habits or new generations integrate these habits when they move into their first homes for example.

In addition, the survey results only estimate direct environmental impacts, excluding the various indirect impacts that come into play. For example, when it comes to purchases, the GHG emissions estimates do not cover the transportation emissions of consumers making their way to shops or equally, that of members travelling to pick-up and bring back objects from a LoT. To partially offset this gap, I enquired on the modes of transportation used by members in the interview with the coordinator of La Manivelle. There are also limitations to the estimations of waste: I only estimated the mass of objects and did not investigate their material composition, if some parts are recycled or the waste's impacts on the environment. Indeed, waste itself is not its own impact on the environment; the consequences of waste disposal are what lead to negative impacts. The findings of this research should be interpreted with these limitations in mind. Finally, the rebound

effects of participating in a LoT were also not considered in the study, yet the importance of these effects are not to be ignored. How does participating in a LoT create rebound effects elsewhere? Does the ability to temporarily access goods incite members to use objects that they otherwise wouldn't have used? Or, on the other hand, does participating in a LoT make users rethink their consumption habits in other areas? These are all questions which merit to be explored in further research.

Moreover, choosing to focus on quantitative methods meant a reduced focus on the qualitative impacts of sharing. Yet the literature review highlights positive direct and indirect impacts of sharing through a LoT which may provide equally as important benefits as the quantitative environmental impacts explored in this research. Because ultimately, the benefits of item-sharing through a LoT go beyond the reduction of GHG emissions, waste reduction and space-saving. It is about promoting a new paradigm of consumption that enables people to meet their basic needs while having a lesser impact on the planet. It involves rethinking our relationship to possessions, materialism, and ownership, as well as our conception of needs and wants. Sharing fosters community resilience in times of crises, as Baden et al (2020) argue, with community-level provision of goods providing "a degree of resilience and community cohesion" (p.18). Therefore, it is crucial to consider both the quantitative and qualitative impacts of item-sharing in future research to fully understand its potential for promoting new modes of sustainable consumption and creating resilient communities.

Therefore, I would recommend future research explores these questions of wider behaviour and system change. For example, interviews with LoT members could provide valuable insights into their motivations, their visions of materialism, prosperity, and wellbeing. To what extent does item-sharing contribute to wellbeing and more equitable consumption patterns? Examining the intersections with environmental justice would also be important to understand the potential impact of item-sharing services on disadvantaged communities. Additionally, exploring the purpose of the item-sharing service and its target audience could shed light on the social and economic implications of LoTs. Does item-sharing cater for the middle-class or wealthy by offering very niche objects or is it to offer more everyday objects to increase quality of life for the lower income groups who otherwise could not have afforded them? Overall, understanding the broader societal

and cultural implications of item-sharing practices can contribute to the development of more sustainable and fair consumption patterns.

Reflecting on case studies of LoTs, Baden et al. (2020) affirm that "despite their innovation, optimism and desire to expand" the LoTs "remained far from achieving the economies of scale required to represent significant competition to the dominant buy-use-dispose model of production and consumption." (p.18). The findings of the quantitative study also highlighted this issue of scale, as the estimated environmental benefits remain small compared to the canton of Geneva's overall environmental footprint. While this study investigated the impact of scaling up sharing practices, it did not delve into the specific strategies and possibilities for achieving such scale. Therefore, further research is needed to explore the concrete pathways and opportunities for scaling up sharing practices, such as policies. This research is especially in the current context of ecological emergency, because to have a significant impact LoTs would have to be scaled-up fast. This could look like government subsidies or even the institutionalisation of LoTs as a service provided by the city or State for example.

Moreover, the literature review highlighted research on the business models of sharing economy platforms and the different impacts of business models on sustainability. The interview conducted with the coordinator of La Manivelle briefly explored the cooperative model. It would be interesting to further explore the cooperative LoT model, looking at the potential for decentralisation, the social impacts, and opportunities for financial self-sufficiency. It is important to further our understanding and knowledge around the different sharing economy models because as Curtis and Mont (2020) affirm, the sharing economy is not sustainable by default. Is the future of the sharing economy, as Frenken (2017) explores in three possible scenarios, Capitalist "a capitalist future culminating in monopolistic super-platforms allowing for seamless services", Statist: "a state-led future that shifts taxation from labour to capital and redistributes the gains of sharing from winners to losers", or Cooperative "a citizen-led future based on cooperatively owned platforms under democratic control" (p.2)? The nature and scale of social and environmental impacts are likely to be very different in each of these three scenarios.

Finally, as mentioned in the literature review, there are also limits to the theoretical approach of Sustainable Consumption. The main objection I encountered is that it displaces the

burden of environmental impacts onto the shoulders of consumers, as Seyfang (2009) and other authors have pointed out. It is important to recognize that relying solely on individual consumer behaviour is inadequate to bring about the scale and speed of the transformations required to address the current environmental crises. That said, one could argue that by circumventing the capitalist dominant way of accessing services, object sharing has the potential to fit within an approach of wider systems change related to infrastructures of provision. Future research could explore the potential role of item-sharing as part of wider shift towards an alternative economic system based on achieving wellbeing for all within the limits of the planet.

7 Conclusion

In this final section, I will identify the critical conclusions from the study's results and their wider implications for our problem statement. The starting point of this research was the urgent need for societies in the Global North to radically change the way they consume to avert disastrous ecological overshoot. Excessive consumption, particularly by a wealthy minority, is responsible for a range of environmental problems that jeopardize the very survival of humanity. As evidenced in the literature review, researchers from various fields have examined the drivers behind high consumption levels in affluent societies, uncovering a complex relationship between consumption and wellbeing. Research identified the importance of distinguishing wellbeing from consumption to open the door to new ways of living a good life which are compatible with the limits of the planet. Such a shift entails a move away from consumerism towards more sustainable modes of consumption. Among these alternative pathways to traditional forms of consumption, the sharing economy, and more specifically item-sharing, was the one I chose to explore in this thesis.

Contrary to common perceptions, researchers have argued that the sharing economy cannot be assumed to be inherently sustainable. Rather, the literature highlighted several factors that contribute to the sustainability of a sharing economy initiative, including its business model, market orientation, ability to leverage the idling capacity of existing goods, and how it enables temporary access over ownership (Fitzmaurice & Schor, 2015; Curtis & Mont, 2020). When it comes to LoTs facilitating the practice of item-sharing, the factors raised in the literature were the objects' origins, product durability, distances and modes of transportation used by the LoT's members (Demailly & Novel, 2014; Baden et al, 2020). In this context, I sought to explore how item-sharing, using the

case-study of a LoT in the canton of Geneva, Switzerland, could contribute to a shift towards more sustainable consumption patterns, in this case exemplified by a reduction in consumption.

In this context, the main question that guided my research was the following: *How can item-sharing, through a Library of Things (LoT), contribute to sustainable consumption?*

The research sub-questions were:

1) *What is the rate of ownership and use of potentially shareable objects by the inhabitants of Geneva?*

2) *How do environmental impacts of ownership compare to environmental impacts of sharing objects?*

3) *What is the potential for reducing environmental pressures on the canton of Geneva if item-sharing were to become widespread?*

Using quantitative methods, I sought to assess the environmental impacts of various sharing scenarios compared to the current state of object ownership. To do so, I first estimated the current rate of potentially shareable objects in Geneva households and their respective frequency of use, using a survey. The findings highlighted that on average, Geneva households own nine potentially shareable objects that they seldom use. The research also highlighted that a proportion of Geneva households show promise for the scaling-up of item-sharing, as well as the selection of objects that have the best potential to be scaled-up based on possession rate, assumptions around household needs, and households' willingness to borrow. Overall, the Geneva households who responded to the survey demonstrated a high intention to participate in item-sharing through a LoT.

Next, I estimated the environmental impacts of current object ownership in the Canton of Geneva for six objects that I subsequently extrapolated to nine objects. I then compared the current object ownership environmental impacts to those of different sharing scenarios to estimate the potential environmental savings. The environmental savings of these hypothetical scenarios represented, without much surprise, a fraction of the overall footprint of the canton of Geneva. The

practice of item-sharing would need to be dramatically scaled up and scaled up fast if it were to have a significant impact on the environmental footprint of the Canton of Geneva based on this research's findings.

Consequently, the research called attention to the challenges faced by LoTs in their ambition to scale-up. The survey results identified households' differentiated willingness to borrow depending on the type of object as well as other psychological barriers to sharing. These elements hinted at the importance of establishing new social and cultural norms surrounding the practice of item-sharing for the practice to spread. Item-sharing, especially through a non-profit cooperative, challenges the dominant consumerist culture and humans' relationship to material things. It offers a local and community-based way of fulfilling needs and invites people to consume less without necessarily sacrificing their wellbeing. The thesis suggested future research pathways to better understand the potential role of LoTs, cooperatives, and the practice of item-sharing overall, in a wider paradigm shift towards achieving wellbeing within the limits of the planet. Furthermore, the research evoked the potential role of policy to support the scaling-up of item-sharing.

As closing words, I hope this research can help La Manivelle, as well as other LoTs and prospective LoTs to advance the understanding of their environmental impact and contribute to their efforts to advocate for political, social, or financial support. I hope that this research can contribute to ongoing efforts to promote alternative and community-based modes of consumption, as well as inspire further research in this area.

References

Alejandre, C., Akizu-Gardoki, O., & Lizundia, E. (2022). Optimum operational lifespan of household appliances considering manufacturing and use stage improvements via life cycle assessment. *Sustainable Production and Consumption*, *32*, 52–65. https://doi.org/10.1016/j.spc.2022.04.007

Alfredsson, E., Bengtsson, M., Brown, H. S., Isenhour, C., Lorek, S., Stevis, D., & Vergragt, P. (2018). Why achieving the Paris Agreement requires reduced overall consumption and production. *Sustainability: Science, Practice and Policy*, *14*(1), 1–5. https://doi.org/10.1080/15487733.2018.1458815

Ameli, N. (2017). Libraries of Things as a new form of sharing. Pushing the Sharing Economy. *The Design Journal*, *20*(sup1), S3294–S3304. https://doi.org/10.1080/14606925.2017.1352833

Arcidiacono, D., Gandini, A., & Pais, I. (2018). Sharing what? The 'sharing economy' in the sociological debate. *The Sociological Review*, *66*(2), 275–288. https://doi.org/10.1177/0038026118758529

Baden, D., Peattie, K., & Oke, A. (2020). Access Over Ownership: Case Studies of Libraries of Things. *Sustainability*, *12*(17), Article 17. https://doi.org/10.3390/su12177180

Behrend, M. (2020). Buying versus renting: On the environmental friendliness of item-sharing. *Transportation Research Part D: Transport and Environment*, *87*, 102407. https://doi.org/10.1016/j.trd.2020.102407

Belk, R. (2010b). Sharing. *Journal of Consumer Research*, *36*(5), 715–734. https://doi.org/10.1086/612649

Belk, R. (2014a). Sharing Versus Pseudo-Sharing in Web 2.0. *The Anthropologist*, *18*(1), 7–23. https://doi.org/10.1080/09720073.2014.11891518

Belk, R. (2014b). You are what you can access: Sharing and collaborative consumption online. *Journal of Business Research*, *67*(8), 1595–1600. https://doi.org/10.1016/j.jbusres.2013.10.001

Benkler, Y. (2004). Sharing Nicely: On Shareable Goods and the Emergence of Sharing as a Modality of Economic Production. *The Yale Law Journal*, *114*(2), 273–358. https://doi.org/10.2307/4135731

Benoit, S., Baker, T. L., Bolton, R. N., Gruber, T., & Kandampully, J. (2017). A triadic framework for collaborative consumption (CC): Motives, activities and resources & capabilities of actors. *Journal of Business Research*, *79*, 219–227. https://doi.org/10.1016/j.jbusres.2017.05.004

Beudon, N. (2017). Le prêt d'objets: Chant du cygne ou renouveau des bibliothèques publiques ? *Nectart*, *N° 5*(2), 87–97.

Bianchi, M., & Cordella, M. (2023). Does circular economy mitigate the extraction of natural resources? Empirical evidence based on analysis of 28 European economies over the past decade. *Ecological Economics*, *203*, 107607. https://doi.org/10.1016/j.ecolecon.2022.107607

Bollino, C. A., & Polinori, P. (2011). Sustainability. In *Energy, Sustainability and the Environment* (pp. 137–164). Elsevier. https://doi.org/10.1016/B978-0-12-385136-9.10006-3

Bolton, L. E., & Alba, J. W. (2012). When less is more: Consumer aversion to unused utility. *Journal of Consumer Psychology*, *22*(3), 369–383. https://doi.org/10.1016/j.jcps.2011.09.002

Botsman, R., & Rogers, R. (2010). *What's Mine Is Yours: The Rise of Collaborative Consumption*. HarperCollins. https://books.google.ch/books?id=LiC2foFeXQYC

Bruckner, B., Hubacek, K., Shan, Y., Zhong, H., & Feng, K. (2022). Impacts of poverty alleviation on national and global carbon emissions. *Nature Sustainability*, 1–10. https://doi.org/10.1038/s41893-021-00842-z

Brundtland, G. H. (1987). *Our Common Future: Report of the World Commission on Environment and Development.* (UN-Document A/42/427.).

Canton de Genève. (2022, March 11). *Bilan et état de la population du canton de Genève en 2021—Canton de Genève / Mars 2022 | Publication*. Office fédéral de la statistique. https://www.bfs.admin.ch/asset/fr/21904077

Capstick, S., Lorenzoni, I., Corner, A., & Whitmarsh, L. (2014). Prospects for radical emissions reduction through behavior and lifestyle change. *Carbon Management*, *5*(4), 429–445.

Chappells, H., & Trentmann, F. (2015). Sustainable consumption in history: Ideas, resources and practices. In L. Reisch & J. Thøgersen, *Handbook of Research on Sustainable Consumption* (pp. 51–69). Edward Elgar Publishing. https://doi.org/10.4337/9781783471270.00011

Chen, D. M.-C., Bodirsky, B. L., Krueger, T., Mishra, A., & Popp, A. (2020). The world's growing municipal solid waste: Trends and impacts. *Environmental Research Letters*, *15*(7), 074021. https://doi.org/10.1088/1748-9326/ab8659

Cherry, C. E., & Pidgeon, N. F. (2018). Is sharing the solution? Exploring public acceptability of the sharing economy. *Journal of Cleaner Production*, *195*, 939–948. https://doi.org/10.1016/j.jclepro.2018.05.278

Creutzig, F., Roy, J., Devine-Wright, P., Díaz-José, J., Geels, F., Grubler, A., Maïzi, N., Masanet, E., Mulugetta, Y., Onyige, C. D., Perkins, P., Sanches-Pereira, A., & Weber, E. (2022). *Demand, Services and Social Aspects of Mitigation* (pp. 503–612). https://doi.org/10.1017/9781009157926.007

Curtis, S. K., & Mont, O. (2020). Sharing economy business models for sustainability. *Journal of Cleaner Production*, *266*, 121519. https://doi.org/10.1016/j.jclepro.2020.121519

Daunorienė, A., Drakšaitė, A., Snieška, V., & Valodkienė, G. (2015a). Evaluating Sustainability of Sharing Economy Business Models. *Procedia - Social and Behavioral Sciences*, *213*, 836–841. https://doi.org/10.1016/j.sbspro.2015.11.486

Demailly, D., & Novel, A.-S. (2014). Économie du partage: Enjeux et opportunités pour la transition écologique. *IDDRI*. https://www.iddri.org/fr/publications-et-evenements/study/economie-du-partage-enjeux-et-opportunites-pour-la-transition

Doughtnut Economics Action Lab. (n.d.). *About Doughnut Economics*. Doughtnut Economics Action Lab. Retrieved 3 April 2022, from https://doughnuteconomics.org/about-doughnut-economics

Easterlin, R. A. (1974). Does Economic Growth Improve the Human Lot? Some Empirical Evidence. In P. A. David & M. W. Reder (Eds.), *Nations and Households in Economic Growth* (pp. 89–125). Academic Press. https://doi.org/10.1016/B978-0-12-205050-3.50008-7

Economy Division. (2021). *Chemicals, Wastes and Climate change: Interlinkages and Potential for Coordinated Action*. https://wedocs.unep.org/20.500.11822/36396

Elgin, D. (2013). Voluntary Simplicity – A Path to Sustainable Prosperity. *Social Change Review*, *11*. https://doi.org/10.2478/scr-2013-0006

Environment, U. N. (2017, September 26). *Solid waste management*. UNEP - UN Environment Programme. http://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/solid-waste-management

Evans, J. R., & Mathur, A. (2018). The value of online surveys: A look back and a look ahead. *Internet Research*, *28*(4), 854–887. https://doi.org/10.1108/IntR-03-2018-0089

Fanning, A. L., & O'Neill, D. W. (2019). The Wellbeing–Consumption paradox: Happiness, health, income, and carbon emissions in growing versus non-growing economies. *Journal of Cleaner Production*, *212*, 810–821. https://doi.org/10.1016/j.jclepro.2018.11.223

Fitzmaurice, & Schor. (2015). *Handbook of research on sustainable consumption* (L. A. Reisch & J. Thøgersen, Eds.). Edward Elgar Publishing.

Frenken, K., & Schor, J. (2017). Putting the sharing economy into perspective. *Environmental Innovation and Societal Transitions*, *23*, 3–10. https://doi.org/10.1016/j.eist.2017.01.003

Fuchs, D., Sahakian, M., Gumbert, T., Giulio, A. D., Maniates, M., Lorek, S., & Graf, A. (2021). *Consumption Corridors: Living a Good Life within Sustainable Limits* (1st ed.). Routledge. https://doi.org/10.4324/9780367748746

Geissinger, A., Laurell, C., Öberg, C., & Sandström, C. (2019). How sustainable is the sharing economy? On the sustainability connotations of sharing economy platforms. *Journal of Cleaner Production*, *206*, 419–429. https://doi.org/10.1016/j.jclepro.2018.09.196

Glossary: Carbon dioxide equivalent. (n.d.). Retrieved 29 January 2023, from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Carbon_dioxide_equivalent

Grinde, B., Nes, R. B., MacDonald, I. F., & Wilson, D. S. (2018). Quality of Life in Intentional Communities. *Social Indicators Research*, *137*(2), 625–640. https://doi.org/10.1007/s11205-017-1615-3

Grosclaude, J.-Y., Pachauri, R. K., & Tubiana, L. (2014). *Innovation for Sustainable Development*. The Energy and Resources Institute (TERI).

Harris, S., Mata, É., Plepys, A., & Katzeff, C. (2021). Sharing is daring, but is it sustainable? An assessment of sharing cars, electric tools and offices in Sweden. *Resources, Conservation and Recycling*, *170*, 105583. https://doi.org/10.1016/j.resconrec.2021.105583

Hertwich, E. G. (2005). Life Cycle Approaches to Sustainable Consumption: A Critical Review. *Environmental Science & Technology*, *39*(13), 4673–4684. https://doi.org/10.1021/es0497375

Hickel, J. (2020). Quantifying national responsibility for climate breakdown: An equality-based attribution approach for carbon dioxide emissions in excess of the planetary boundary. *The Lancet Planetary Health*, *4*(9), e399–e404. https://doi.org/10.1016/S2542-5196(20)30196-0

Hickel, J. (2021). What does degrowth mean? A few points of clarification. *Globalizations*, *18*(7), 1105–1111. https://doi.org/10.1080/14747731.2020.1812222

Hickel, J., O'Neill, D. W., Fanning, A. L., & Zoomkawala, H. (2022). National responsibility for ecological breakdown: A fair-shares assessment of resource use, 1970–2017. *The Lancet Planetary Health*, *6*(4), e342–e349. https://doi.org/10.1016/S2542-5196(22)00044-4

Hirsch, F. (1976). *Social Limits to Growth*. Harvard University Press. https://doi.org/10.4159/harvard.9780674497900

Ivanova, D., & Büchs, M. (2020). Household Sharing for Carbon and Energy Reductions: The Case of EU Countries. *Energies*, *13*(8), Article 8. https://doi.org/10.3390/en13081909

Ivanova, D., & Büchs, M. (2022). Implications of shrinking household sizes for meeting the 1.5 °C climate targets. *Ecological Economics*, *202*, 107590. https://doi.org/10.1016/j.ecolecon.2022.107590

Ivanova, D., Stadler, K., Steen-Olsen, K., Wood, R., Vita, G., Tukker, A., & Hertwich, E. G. (2016). Environmental Impact Assessment of Household Consumption: Environmental Impact Assessment of Household Consumption. *Journal of Industrial Ecology*, *20*(3), 526–536. https://doi.org/10.1111/jiec.12371

Jackson, T. (2008). Live Better by Consuming Less?: Is There a "Double Dividend" in Sustainable Consumption? *Journal of Industrial Ecology*, *9*(1–2), 19–36. https://doi.org/10.1162/1088198054084734

Jackson, T. (2009). *Prosperity without Growth* (0 ed.). Routledge. https://doi.org/10.4324/9781849774338

Jackson, T. (2011). Societal transformations for a sustainable economy: Societal Transformations for a Sustainable Economy. *Natural Resources Forum*, *35*(3), 155–164. https://doi.org/10.1111/j.1477-8947.2011.01395.x

Jackson, T. (2014). Sustainable consumption. In G. Atkinson, S. Dietz, E. Neumayer, & M. Agarwala, *Handbook of Sustainable Development* (pp. 279–290). Edward Elgar Publishing. https://doi.org/10.4337/9781782544708.00029

Jean, C. (2020, February 19). *Must we stop taking pictures to save the planet?* Blind Magazine. https://www.blind-magazine.com/stories/must-we-stop-taking-pictures-to-save-the-planet/

Jolliet, O., Saade-Sbeih, M., Shaked, S., Jolliet, A., & Crettaz, P. (2016). *Environmental life cycle assessment*. CRC Press. https://doi.org/10.1201/b19138

Juliet B. Schor & Connor J. Fitzmaurice. (2015). *Collaborating and connecting: The emergence of the sharing economy*. 410–425. https://doi.org/10.4337/9781783471270.00039

Kaza, S., Yao, L. C., Bhada-Tata, P., & Van Woerden, F. (2018). *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. World Bank. https://doi.org/10.1596/978-1-4648-1329-0

Lamb, W. F., & Steinberger, J. K. (2017). Human well-being and climate change mitigation. *WIREs Climate Change*, *8*(6), e485. https://doi.org/10.1002/wcc.485

Lawson, S. J., Gleim, M. R., Perren, R., & Hwang, J. (2016). Freedom from ownership: An exploration of access-based consumption. *Journal of Business Research*, *69*(8), 2615–2623. https://doi.org/10.1016/j.jbusres.2016.04.021

Lorek, S., & Vergragt, P. J. (2015). Sustainable consumption as a systemic challenge: Inter- and transdisciplinary research and research questions. In *Handbook of research on sustainable consumption.* (pp. 19–32). Edward Elgar Publishing. https://doi.org/10.4337/9781783471270

Luri Minami, A., Ramos, C., & Bruscato Bortoluzzo, A. (2021). Sharing economy versus collaborative consumption: What drives consumers in the new forms of exchange? *Journal of Business Research*, *128*, 124–137. https://doi.org/10.1016/j.jbusres.2021.01.035

Ma, B., Li, X., Jiang, Z., & Jiang, J. (2019). Recycle more, waste more? When recycling efforts increase resource consumption. *Journal of Cleaner Production*, *206*, 870–877. https://doi.org/10.1016/j.jclepro.2018.09.063

Mannan, M., & Pek, S. (2021). Solidarity in the Sharing Economy: The Role of Platform Cooperatives at the Base of the Pyramid. In I. Qureshi, B. Bhatt, & D. M. Shukla (Eds.), *Sharing Economy at the Base of the Pyramid: Opportunities and Challenges* (pp. 249–279). Springer Nature. https://doi.org/10.1007/978-981-16-2414-8_11

Martin, C. J. (2016). The sharing economy: A pathway to sustainability or a nightmarish form of neoliberal capitalism? *Ecological Economics*, *121*, 149–159. https://doi.org/10.1016/j.ecolecon.2015.11.027

Martin-Woodhead, A. (2021). Limited, considered and sustainable consumption: The (non)consumption practices of UK minimalists. *Journal of Consumer Culture*, 14695405211039608. https://doi.org/10.1177/14695405211039608

Max-Neef, M. A., Elizalde, A., & Hopenhayn, M. (1991). *Human scale development: Conception, application and further reflections.* The Apex Press.

McLaren, D., & Markusson, N. (2020). The co-evolution of technological promises, modelling, policies and climate change targets. *Nature Climate Change*, *10*(5), Article 5. https://doi.org/10.1038/s41558-020-0740-1

Meadows, D., Meadows, D. L., Randers, J., & Behrens III, W. W. (1972). *The Limits to Growth*. New York : Universe Books, [1972]. https://search.library.wisc.edu/catalog/999473210902121

Mi, Z., & Coffman, D. (2019). The sharing economy promotes sustainable societies. *Nature Communications*, *10*(1), 1214. https://doi.org/10.1038/s41467-019-09260-4

Miguel, C., Martos-Carrión, E., & Santa, M. (2022). A Conceptualisation of the Sharing Economy: Towards Theoretical Meaningfulness. *The Sharing Economy in Europe*, 21–40. https://doi.org/10.1007/978-3-030-86897-0_2

Mont, O., Palgan, Y. V., Bradley, K., & Zvolska, L. (2020). A decade of the sharing economy: Concepts, users, business and governance perspectives. *Journal of Cleaner Production*, *269*, 122215. https://doi.org/10.1016/j.jclepro.2020.122215

Norwegian Ministry of Environment. (1995). *Oslo Ministerial Roundtable: Conference on Sustainable Production and Consumption*. Government of Norway Oslo.

Oberle, B., Bringezu, S., Hatfeld-Dodds, S., Hellweg, S., Schandl, H., Clement, J., Cabernard, L., & Che, N. (2018). *Global Resources Outlook Global Resources Oulook*. International Resource

Panel. United Nations Environment Programme. https://www.resourcepanel.org/reports/global-resources-outlook

OECD. (2019). *Waste Management and the Circular Economy in Selected OECD Countries: Evidence from Environmental Performance Reviews*. OECD. https://doi.org/10.1787/9789264309395-en

OFEV, O. fédéral de l'environnement. (n.d.). *Matières premières, déchets et économie circulaire: En bref*. Retrieved 27 January 2023, from https://www.bafu.admin.ch/bafu/fr/home/themen/thema-abfall/abfall--das-wichtigste-in-kuerze.html

Office cantonal de la statistique. (n.d.). Retrieved 29 December 2022, from https://statistique.ge.ch/domaines/apercu.asp?dom=01_05

Office fédéral de la statistique (n.d.). *Revenu professionnel relatif*. Retrieved 6 January 2023, from https://www.bfs.admin.ch/bfs/fr/home/statistiken/bildung-wissenschaft/bildungsindikatoren/themen/wirkung/erwerbseinkommen.html

Office fédéral de la statistique. (2022, April 5). *Niveau de formation de la population – Données de l'indicateur—2000-2021 | Tableau*. Office fédéral de la statistique. https://www.bfs.admin.ch/asset/fr/22024468

Otto, I. M., Kim, K. M., Dubrovsky, N., & Lucht, W. (2019). Shift the focus from the super-poor to the super-rich. *Nature Climate Change*, *9*(2), Article 2. https://doi.org/10.1038/s41558-019-0402-3

Parrique, T., Barth, J., Briens, F., Spangenberg, J., & Kraus-Polk, A. (2019). *Decoupling Debunked. Evidence and arguments against green growth as a sole strategy for sustainability. A study edited by the European Environment Bureau EEB.*

Philip, H. E., Ozanne, L. K., & Ballantine, P. W. (2015). Examining temporary disposition and acquisition in peer-to-peer renting. *Journal of Marketing Management, 31*(11–12), 1310–1332. https://doi.org/10.1080/0267257X.2015.1013490

Plewnia, F., & Guenther, E. (2018). Mapping the sharing economy for sustainability research. *Management Decision, 56*(3), 570–583. https://doi.org/10.1108/MD-11-2016-0766

Pouri, M. J. (2022). Shareable Goods and Impacts on Consumption; The Case of Digital Sharing Platforms. In V. Wohlgemuth, S. Naumann, G. Behrens, & H.-K. Arndt (Eds.), *Advances and New Trends in Environmental Informatics* (pp. 257–272). Springer International Publishing. https://doi.org/10.1007/978-3-030-88063-7_16

Raworth, K. (2017). *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist*. Chelsea Green Publishing.

Roberts, J. T., Steinberger, J. K., Dietz, T., Lamb, W. F., York, R., Jorgenson, A. K., Givens, J. E., Baer, P., & Schor, J. B. (2020). Four agendas for research and policy on emissions mitigation and well-being. *Global Sustainability, 3*, e3. https://doi.org/10.1017/sus.2019.25

Schor, J. (1998). *The Overspent American: Upscaling, Downshifting, and the New Consumer*. Basic Books. https://books.google.ch/books?id=cdkvIE72FMYC

Schor, J. (1999). The New Politics of Consumption. *Boston Review*. https://www.bostonreview.net/forum/juliet-b-schor-new-politics-consumption/

Schor, J. (2010). *Plenitude: The New Economics of True Wealth*. Penguin Press.

Schor, J. (2014, July 29). The New Politics of Consumption. *Boston Review*. https://bostonreview.net/forum/juliet-b-schor-new-politics-consumption/

Schor, J. (2015). On the sharing economy. *Contexts*, *Vol. 14*(No. 1), 12–19.

Schor, J. (2016). Debating the Sharing Economy. *Journal of Self-Governance and Management Economics*, *4*(3), 7–22.

Schreiner, N., Pick, D., & Kenning, P. (2018). To share or not to share? Explaining willingness to share in the context of social distance. *Journal of Consumer Behaviour*, *17*(4), 366–378. https://doi.org/10.1002/cb.1717

Seyfang, G. (2009). *The New Economics of Sustainable Consumption*. Palgrave Macmillan UK. https://doi.org/10.1057/9780230234505

Shaw, D., & Newholm, T. (2002). Voluntary simplicity and the ethics of consumption. *Psychology and Marketing*, *19*(2), 167–185. https://doi.org/10.1002/mar.10008

Silvestri, L., Forcina, A., Silvestri, C., & Ioppolo, G. (2020). Life cycle assessment of sanitaryware production: A case study in Italy. *Journal of Cleaner Production*, *251*, 119708. https://doi.org/10.1016/j.jclepro.2019.119708

Sonnemann, G., Gemechu, E. D., Sala, S., Schau, E. M., Allacker, K., Pant, R., Adibi, N., & Valdivia, S. (2018). Life Cycle Thinking and the Use of LCA in Policies Around the World. In M. Z. Hauschild, R. K. Rosenbaum, & S. I. Olsen (Eds.), *Life Cycle Assessment* (pp. 429–463). Springer International Publishing. https://doi.org/10.1007/978-3-319-56475-3_18

Sun, S., & Ertz, M. (2021). Theory-Based Roadmap for Assessing Sustainability in the Collaborative Economy. *Frontiers in Psychology*, *12*, 4574. https://doi.org/10.3389/fpsyg.2021.752867

Thalmann, P., & Vielle, M. (2019). Lowering CO_2 emissions in the Swiss transport sector. *Swiss Journal of Economics and Statistics*, *155*(1), 10. https://doi.org/10.1186/s41937-019-0037-3

Vaileanu-Paun, I., & Boutillier, S. (2012). Économie de la fonctionnalité. Une nouvelle synergie entre le territoire, la firme et le consommateur ?: *Innovations*, *n°37*(1), 95–125. https://doi.org/10.3917/inno.037.0095

Van Selm, M., & Jankowski, N. W. (2006). Conducting Online Surveys. *Quality and Quantity*, *40*(3), 435–456. https://doi.org/10.1007/s11135-005-8081-8

Veblen, T., 1857-1929. (1994). *The theory of the leisure class*. New York, N.Y., U.S.A. : Penguin Books, 1994. https://search.library.wisc.edu/catalog/999750315702121

Vita, G., Ivanova, D., Dumitru, A., García-Mira, R., Carrus, G., Stadler, K., Krause, K., Wood, R., & Hertwich, E. G. (2020). Happier with less? Members of European environmental grassroots initiatives reconcile lower carbon footprints with higher life satisfaction and income increases. *Energy Research & Social Science*, *60*, 101329. https://doi.org/10.1016/j.erss.2019.101329

Voytenko Palgan, Y., Zvolska, L., & Mont, O. (2017). Sustainability framings of accommodation sharing. *Environmental Innovation and Societal Transitions*, *23*, 70–83. https://doi.org/10.1016/j.eist.2016.12.002

Wackernagel, M., Beyers, B., & Rout, K. (2019). *Ecological Footprint: Managing Our Biocapacity Budget*. New Society Publishers. https://books.google.ch/books?id=qCQ8wQEACAAJ

Westervelt, A. (2022, April 6). Drilled Down: Debunking Demand (IPCC Mitigation Report, Part 1). *Drilled*. https://www.drilledpodcast.com/debunking-demand-ipcc-mitigation-report-part-1/

Wiedmann, T. O., Schandl, H., Lenzen, M., Moran, D., Suh, S., West, J., & Kanemoto, K. (2015). The material footprint of nations. *Proceedings of the National Academy of Sciences*, *112*(20), 6271–6276. https://doi.org/10.1073/pnas.1220362110

Wilkinson, R. D., & Pickett, K. (2009). *The spirit level: Why more equal societies almost always do better*. (pp. xvii, 331). Bloomsbury Publishing.

Zervas, G., Proserpio, D., & Byers, J. W. (2017). The Rise of the Sharing Economy: Estimating the Impact of Airbnb on the Hotel Industry. *Journal of Marketing Research*, *54*(5), 687–705. https://doi.org/10.1509/jmr.15.0204

Zhu, Y., Keoleian, G. A., & Cooper, D. R. (2023). A parametric life cycle assessment model for ductile cast iron components. *Resources, Conservation and Recycling*, *189*, 106729. https://doi.org/10.1016/j.resconrec.2022.106729

Zukin, S., & Maguire, J. S. (2004). Consumers and Consumption. *Annual Review of Sociology*, *30*, 173–197.

Appendices

Appendix A – Additional detail related to the estimations of objects' carbon emissions

Object	Main material	Cradle-to-gate kg CO_2e/ kg or /ton	Object mass (kg) *(Appendix B)*	Cradle-to-gate (kg CO_2e / unit)	Source
Sleeping bag	Virgin polyester filament	14.2 kg CO_2e/kg	1	14.2	*Base Empreinte*, ADEME, 2023
	Recycled polyester filament	6.59 kg CO_2e/kg		6.59	*Base Empreinte*, ADEME
Raclette machine	N/A	N/A	N/A	16.8	*Base Empreinte*, ADEME, 2023
Fondue kit	Cast iron	2.19 kg CO_2e/kg	3.35	7.34	Zhu et al., 2023
	Ceramic	2.2 kg CO_2e /kg	2.95	6.48	Silvestri et al., 2020
Camera	N/A	N/A	N/A	24.4	*Base Empreinte*, ADEME, 2023
Folding step ladder	Virgin Aluminium	7803 kg CO_2e/ton	4.00	31.2	*Base Empreinte*, ADEME, 2023
	Recycled aluminium	562 kg CO_2e/ton		2.2	*Base Empreinte*, ADEME, 2023
Drill-driver	N/A	N/A	N/A	23.5	*Base Empreinte*, ADEME, 2023

Table A 1

<u>The sleeping bag</u>

The main component of a sleeping bag is commonly polyester. Due to the absence of existing data on the life cycle of a sleeping bag, I estimated its impact by multiplying its mass with the kg CO_2e of a kg of polyester. I did the calculation twice: once to calculate the CO_2e

emissions of a sleeping bag made from virgin polyester (Table A2) and another for a sleeping bag made from recycled polyester (Table A3). I found the data on CO_2e of virgin polyester and recycled polyester in the ADEME *Base Empreinte* database (ADEME, 2023). In the absence of data, this analysis only includes the carbon emissions of the production stage and excludes carbon emissions of the assembling and the transport of the sleeping bag.

Table A 2

Table A 3

The raclette machine

The cradle-to-gate LCA data for the raclette machine (Table A4) comes directly from the ADEME's *Base empreinte* database (ADEME, 2023). The data that figures in the database comes from a 2019 report, which includes more detail as to how the cradle-to-gate LCA was conducted (ADEME, 2019).

Appareil à raclettes 6-8p

France continentale

16.8
kg éq. CO2/unité

Masquer les détails | Voir la documentation

Informations Générales | Indicateurs d'impacts | Flux GES | Informations additionnelles | Flux intermédiaires

Type poste	CO_{2f}	CH_{4f}	CH_{4b}	N_2O	Autre Gaz	Total	CO_{2b}
Intrants (Matières premières)	10.0	0	0	0	0	10.0	0
Transport (Approvisionneme	1.71	0	0	0	0	1.71	0
Energie (Mise en forme)	4.02	0	0	0	0	4.02	-0.267
Total	15.8	0	0	0	0	15.8	-0.267

* On utilise les PRG du 5ème rapport du GIEC (2013) sans prise en compte de la rétroaction climatique.

Table A 4

The fondue set

The main part of a fondue set is the fondue pot, a cooking vessel, which is traditionally made from enamelled cast iron but today versions can be found in ceramic or porcelain. In addition to the fondue pot, the set is also composed of a wrought iron rechaud and fondue forks. For the purpose of this study, I analysed the carbon emissions of a fondue pot made from cast iron and one made of ceramic. Due to the absence of existing data on the CO_2e of neither a cast iron fondue pot nor a ceramic fondue pot, I estimated it myself. For the ceramic pot, I used data for sanitaryware from a study by Silvestri et al., (2020). There are obviously differences between a ceramic bowl and ceramic sanitaryware, but I am assuming that some processes, like the extraction of raw materials

and their transformation would likely be quite similar. For the cast iron fondue pot, I used a study by Zhu et al., 2023 which had estimates for kg CO_2e per kg of cast iron. In the absence of data, this analysis only includes the carbon emissions of the production stage, and excludes carbon emissions of the assembling and the transport of the fondue pot.

The camera

The cradle-to-gate LCA data for the camera (Table A5) comes from the ADEME's *Base empreinte* database (ADEME, 2023). The type of camera featured in this research is a compact camera. The data that figures in the database comes from a 2018 report, which includes more detail as to how the cradle-to-gate LCA was conducted (ADEME, 2018).

Appareil photo/Compact

France continentale

24.4
kg éq. CO2/unité

Masquer les détails | Voir la documentation

Informations Générales | Indicateurs d'impacts | Flux GES | Informations additionnelles | Flux intermédiaires

Type poste	Total non décomposé
Intrants (Matières premières)	22.9
Transport (Approvisionnement)	0.404
Energie (Mise en forme)	0.195
Energie (Assemblage)	0.179
Transport (Distribution)	0.747
Total	24.4

* On utilise les PRG du 5ème rapport du GIEC (2013) sans prise en compte de la rétroaction climatique.

Table A 5

The folding step ladder

Folding step ladders are commonly made with aluminium. Due to the absence of existing data on the carbon emissions of a folding step tool, I estimated its impact by multiplying its mass with

the kg CO_2e of a kg of aluminium. I did the calculation twice: once to calculate the CO_2e emissions of a folding step ladder in aluminium (see Table A6) and another in recycled aluminium (see Table A7). I found the data on CO_2e of aluminium and recycled aluminium in the ADEME's *Base empreinte* database (ADEME, 2023). In the absence of data, this analysis only includes the carbon emissions of the production stage and excludes carbon emissions of the assembling and the transport of the folding step.

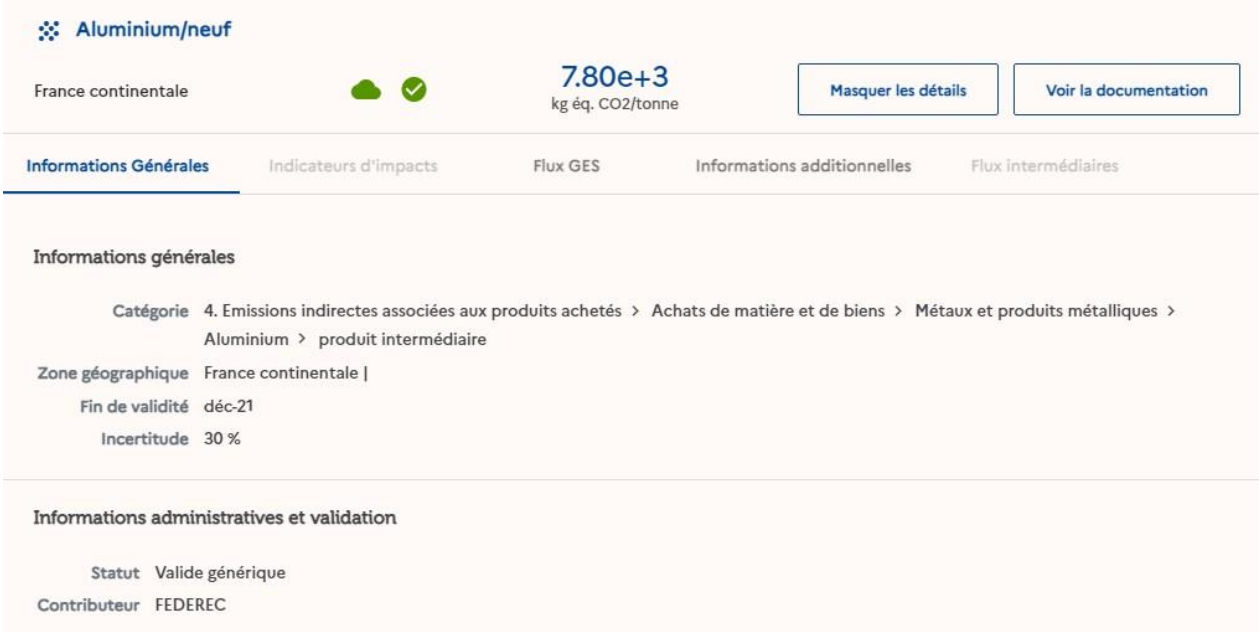

Table A 6

Table A 7

The drill-driver

The cradle-to-gate LCA data for the drill-driver (see Table A8) comes from the ADEME's *Base empreinte* database (ADEME, 2023). The data that figures in the database comes from a 2019 report, which includes more detail as to how the cradle-to-gate LCA was conducted (ADEME, 2019).

Perceuse-visseuse (sans fil)

France continentale

23.5
kg éq. CO2/unité

Masquer les détails | Voir la documentation

Informations Générales | Indicateurs d'impacts | Flux GES | Informations additionnelles | Flux intermédiaires

Type poste	CO_{2f}	CH_{4f}	CH_{4b}	N_2O	Autre Gaz	Total	CO_{2b}
Intrants (Matières premières)	15.0	0	0	0	0	15.0	0
Transport (Approvisionneme	2.44	0	0	0	0	2.44	0
Energie (Mise en forme)	4.65	0	0	0	0	4.65	-0.0190
Total	22.1	0	0	0	0	22.1	-0.0190

*On utilise les PRG du 5ème rapport du GIEC (2013) sans prise en compte de la rétroaction climatique.

Table A 8

Appendix B - Additional detail related to the estimations of object mass

The average mass of each object was estimated by identifying the average mass of similar objects featured in online stores, except for the cast iron fondue kit. I was not able to find the data online and therefore I resorted to weighing the cast iron fondue pot that I had at home.

Sleeping bag	**Link**	**Mass (kg)**
La Manivelle	https://manivelle.myturn.com/library/inventory/show/316969	N/A
Snowleader	https://www.snowleader.ch/fr/active-5-dark-bronze-LAFU00602.html	0.98
Ochsner	https://www.ochsnersport.ch/fr/shop/46-nord-polar-extreme-sac-de-couchage-zip-l-bleu-0000200146896100000002-p.html	1
Decathlon	https://www.decathlon.fr/p/sac-de-couchage-de-trekking-mt500-5-c-polyester/_/R-p-311218	1.1
Average mass of a sleeping bag (rounded off to the nearest decimal)		**1**

Table B 1 – Sleeping bag mass source

Raclette machine	**Link**	**Mass (kg)**
La Manivelle	https://manivelle.myturn.com/library/inventory/show/522629	N/A
Ttmsa	https://www.ttmsa.ch/fr/shop-online/fours-et-accessoires-pour-la-raclette/raclonnette-/raclette-suisse-38	4.8kg
Fnac	https://www.fr.fnac.ch/Raclette-pour-10-personnes-Tefal-Inox-et-Design-1350-W/a12874195	6,74
M electronics	https://www.melectronics.ch/fr/p/785300149063/trisa-electronics-raclette-style-8	2.6
Average mass of a raclette machine (rounded off to the nearest decimal)		**4.7**

Table B 2 - Raclette machine mass source

Ceramic fondue set	Link	Mass (kg)
La Manivelle	https://manivelle.myturn.com/library/inventory/show/522913	N/A
Kuhn Rikon	https://kuhnrikon.com/fr/sale/fondue-au-fromage-set-alpes-o-22-cm-32178.html	2.945
Average mass of a ceramic fondue set (rounded off to the nearest decimal)		2.945

Table B 3 – Ceramic fondue set mass source

Cast iron fondue set	Mass (kg)
Cast iron fondue set (my own measurements using the one I owned)	3.35

Table B 4 – Cast iron fondue set mass source

Camera	Link	Mass (g)
La Manivelle	https://manivelle.myturn.com/library/inventory/browse?q=photo&sort=score&view=grid&perPage=15&location=1766	N/A
Media Market	https://www.mediamarkt.ch/fr/product/_sony-cyber-shot-dsc-w810-1400337.html	111
Digitec	https://www.digitec.ch/en/s1/product/sony-cyber-shot-dsc-w810-26-156-mm-2010-mpx-123-cameras-2447197	137
Galaxus	https://www.galaxus.ch/fr/s1/product/agfa-dc5200-21-mpx-appareil-photo-13087922 -sans promotion.	90
Average mass of a compact photo camera (rounded off to the nearest decimal)		**113**

Table B 5 – Compact photo camera mass source

Drill-driver	Link	Mass (g)
La Manivelle	https://manivelle.myturn.com/library/inventory/show/305416	1.2
Hornbach	https://www.hornbach.ch/shop/Makita-Perceuse-visseuse-sans-fil-18V-DDF482RFJ-avec-2batteries-3-0Ah-chargeur-et-	1.7

	MAKPAC/10076142/article.html?sourceArt=10076817&url=10076142&trackArticleCrossType=vv	
Mytoolsswiss.ch	https://mytoolswiss.ch/fr/perceuse-visseuse/109-perceuse-visseuse-18-v-makita-ddf484zj.html	1.8
Average mass of a drill-driver (rounded off to the nearest decimal)		**1.6**

Table B 6 – Drill-driver mass source

Folding step ladder	**Link**	**Mass (kg)**
La Manivelle	https://manivelle.myturn.com/library/inventory/show/378090	N/A
Jumbo	https://www.jumbo.ch/fr/sejour-eclairage/articles-menagers/accessoires-menagers/escabeaux-marchepieds/escabeaux/escabeau-4-marches/p/6925252	3.925
OBI	https://www.obi.ch/fr/echelles-et-marchepieds/hailo-echelle-de-menage-alu-l58-4-marches/p/2028686?lng=fr_CH	4.4
Hornbach	https://www.hornbach.ch/shop/Escabeau-Kaiserthal-en-aluminium-4-marches/10302092/article.html	3.7
Average mass of a folding step ladder (rounded off to the nearest decimal)		**4.00**

Table B 7 - Folding step ladder mass source

Appendix C - Estimation of the volume of objects

Object	**Dimensions (cm)**	**Volume (cm^3)**	**Volume, including the extra 10% (cm^3)**
Compact photo camera	9.6.cm x 5.5 cm x 2.1 cm	110.88	121.968
Sleeping bag	L 40 cm Ø 18 cm	65144.07	71658.477
Raclette machine	11 cm x 45 x 23cm	11385	12523.5
Fondue kit	20cm x 24cm x 31cm	14880	16368
Drill-driver	39.5 x 29.5x 15.7	18294.425	20123.8675
Folding step ladder	146,0 cm x 46 cm x 90	604440	664884

Table C 1 – Estimations of objects' dimensions

Object	**Source**
Compact photo camera	https://www.mediamarkt.ch/fr/product/_sony-cyber-shot-dsc-w810-1400337.html#sp_C3_A9cifications
Sleeping bag	https://www.decathlon.fr/p/sac-de-couchage-de-trekking-mt500-5-c-polyester/_/R-p-311218
Raclette machine	https://www.ttmsa.ch/fr/shop-online/fours-et-accessoires-pour-la-raclette/raclonnette-/raclette-suisse-38
Fondue kit	Calculation made by myself
Drill-driver	https://www.racetools.fr/coffret-mak-pac/798-coffret-empilable-mak-pac-taille-2-makita-821550-0-0088381702942.html?lgw_code=48251-798&gclid=CjwKCAiAkfucBhBBEiwAFjbkr3DYwCA0YvRXFCT9nSkBGBajJjR3_Ca68nCuIWxEykUSsbM7eEaa9BoCm_gQAvD_BwE
Folding step ladder	https://www.obi.ch/fr/echelles-et-marchepieds/hailo-echelle-de-menage-alu-l58-4-marches/p/2028686?lng=fr_CH

Table C 2 - Sources of object dimensions

Appendix D – Statistical analysis report (in French)

Rapport analyses statistiques – Élaboré par Lisa Abiven

Population : GENEVE

- 533 participant.es genevois (base de données complète + donné leur consentement)
- 372 participant.es genevois (terminé le questionnaire + donné leur consentement)

Connaissance du principe des bibliothèques d'objets :

- 404 oui (74.4%)
- 139 non (25.6%)

Membre d'une bibliothèque d'objets : *(404 réponses, 74.4% des participant.es Gv)*

- 34 oui (8.4%)
- 348 non (86.1%)
- 18 a été mais ne l'est plus (4.5%)

Inventaire des objets

Score des objets :

Statistiques

score_nb_objet

N	Valide	533
	Manquant	0
Moyenne		7,95
Médiane		7,00

Totalité des participants genevois

Statistiques

score_nb_objet

N	Valide	454
	Manquant	0
Moyenne		9,33
Médiane		8,00

Ceux qui ont donné un score différent de 0

Inventaire : *(473 réponses, 89% des participant.es Gv)*

- Projecteur vidéo : 76 (16.1%)
- Machine à coudre : 161 (34.0%)
- **4) Appareil photo : 238 (50.3%)**
- Paire de béquilles : 123 (26.0%)
- Paire de raquette à neige : 86 (18.2%)
- Luge de neige : 81 (17.1%)
- **1) Sac de couchage : 293 (61.9%)**
- Tente de camping : 182 (38.5%)
- Matelas de sol pour camping : 171 (36.2%)
- Réchaud de camping : 87 (18.4%)
- Bateau gonflable : 72 (15.2%)
- Sacoche pour vélo : 103 (21.8%)
- Remorque pour vélo : 24 (5.1%)
- Plaque de cuisson portable : 67 (14.2%)
- **2) Four à raclette : 273 (57.7%)**
- Appareil à faire des crêpes : 164 (34.7%)
- Robot de cuisine : 122 (25.8%)
- Sorbetière : 39 (8.2%)
- Déshydrateur alimentaire : 25 (5.3%)
- Friteuse électrique : 56 (11.8%)
- **3) Service à fondue au fromage : 285 (60.3%)**
- Fer à bricelets / Gaufrier : 80 (16.9%)
- Appareil à panini / sandwich : 115 (24.3%)
- **6) Perceuse-visseuse : 227 (48%)**
- Ponceuse excentrique : 41 (8.7%)
- Marteau perforateur : 43 (9.1%)
- Scie à onglets : 14 (3%)
- Meuleuse d'angle : 23 (4.9%)
- Rabot électrique : 19 (4%)
- Scie sauteuse : 82 (17.3%)
- Scie circulaire : 26 (5.5%)
- Enrouleur électrique : 133 (28.1%)
- Diable à pelle : 66 (14%)
- **5) Escabeau pliant : 231 (48.8%)**
- Nettoyeur à vapeur : 44 (9.3%)
- Nettoyeur à haute pression : 52 (11%)
- Broyeur de végétaux : 11 (2.3%)
- Taille-haies : 49 (10.4%)
- Grande bâche plastique : 80 (16.9%)
- Pavillon de jardin amovible : 35 (7.4%)
- Pelle/ Pioche/ Râteau /etc. : 86 (18.2%)
- Débrousailleuse : 51 (10.8%)

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1) Sac de couchage

- 1 ➔ 95 (36.7%)
- 2 ➔ 102 (39%)

- 3 ➔ 25 (9.7%)
- 4 ➔ 26 (10%)
- + que 4➔ 11 (4.6%)

Volonté de partage : Oui ➔ 69 (27.8%) / Non ➔ 179 (72.2%)

2) Service fondue au fromage

- 1 ➔ 193 (83.9%)
- 2 ➔ 29 (12.6%)
- + que 2 ➔ 8 (3.5%)

Volonté de partage : Oui ➔ 149 (68%) / Non ➔ 70 (32%)

3) Four à raclette

- 1 ➔ 197 (87.6%)
- 2 ➔ 23 (10.2%)
- + que 2 ➔ 5 (2.2%)

Volonté de partage : Oui ➔ 158 (72.8%) / Non ➔ 59 (27.2%)

4) Appareil photo

- 1 ➔ 128 (57.9%)
- 2 ➔ 62 (28.1%)
- 3 ➔ 21 (9.5%)
- + que 3 ➔ 10 (4.5%)

Volonté de partage : Oui ➔ 143 (67.5%) / Non ➔ 69 (32.5%)

5) Escabeau pliant

- 1 ➔ 149 (83.7%)
- 2 ➔ 23 (12.9%)
- 3 ➔ 4 (2.2%)
- + que 3 ➔ 2 (1.1%)

Partage : Oui ➔ 116 (67.1%) / Non ➔ 57 (32.9%)

6) Perceuse-visseuse

- 1 ➔ 165 (91.2%)
- 2 ➔ 12 (6.6%)
- + que 2 ➔ 4 (2.2%)

Partage : Oui ➔ 147 (81.7%) / Non ➔ 33 (18.3%)

Fréquence d'utilisation des objets sur une année

	Calcul appareil photo	Calcul Sac couchage	Calcul Four raclette	Calcul Service fondue fromage	Calcul Perceuse viseuse	Calcul Escabeau pliant
N Valide	212	243	214	219	173	172
Manquant	321	290	319	314	360	361
Moyenne	62.65	32.10	10.93	10.00	28.47	41.63
Médiane	12.00	3.00	6.00	5.00	10.00	15.00
Ecart type	142.247	334.651	23.440	22.863	53.387	68.455
Minimum	0	0	0	0	0	0
Maximum	1092	5110	312	312	365	365

Facilitateurs et Barrières psychologiques

Facilitateurs psychologiques :

- Pratique pour des objets rarement utilisés : 349 (93.8%)
- Préserver l'environnement : 283 (76.1%)
- Gain de place : 265 (71.2%)
- Raisons économiques : 267 (71.8%)
- Opportunité de tester des objets : 185 (49.7%)
- Tester un objet avant l'acheter : 128 (34.4%)
- Faire partie d'une communauté : 72 (19.4%)

Barrières psychologiques :

- Raisons logistiques (trop loin, pas assez de temps) : 237 (63.7%)
- Préoccupation mauvaise hygiène : 176 (47.3%)
- Emprunt déjà dans entourage : 144 (38.7%)
- Peur de casser les objets : 110 (29.6%)
- Dépendance vis-à-vis des autres : 65 (17.5%)
- Pas besoin d'emprunter : 23 (6.2%)
- Préférence objets neufs : 10 (2.7%)

Attitude environnementale et Intention comportementale

***Attitude environnementale* :** Je me considère comme une personne qui agit pour l'environnement

Moyenne ➔ 4.16 (échelle de Likert en 5 points)

➔ *Les genevois estiment avoir une attitude environnementale élevée (M=4.16, SD= .76)*

Intention comportementale :

Intention B.O : Veuillez indiquer dans quelle mesure vous avez l'intention d'emprunter des objets à la Manivelle (ou autre bibliothèque d'objets)

Moyenne ➔ 4.03 (échelle de Likert en 5 points)

➔ *Chez les genevois, l'intention d'emprunter des objets à la Manivelle ou dans une autre bibliothèque d'objets est élevée (M=4.03, SD= .72)*

Intention services de partage : Veuillez indiquer dans quelle mesure vous avez l'intention d'utiliser d'autres services de partage (e.g. Partage de vélos, voitures, logements etc.)

Moyenne ➔ 3.55 (échelle de Likert en 5 points)

➔ *Chez les genevois, l'intention d'utiliser d'autres services de partage est relativement élevé (M=3.55, SD= 1.06)*

Intention d'emprunt des objets : Si vous ne possédez pas « OBJET », seriez-vous prêt.e à l'emprunter dans une bibliothèque commune ?

Moyenne ➔ .48 (-1 à 1)

Analyses supplémentaires

- ***Effet de l'attitude environnementale sur l'intention B.O***
  B=.211, t(370)=4.44, p<.001 ➔ plus les individus ont une attitude environnementale élevée plus ils ont l'intention d'emprunter dans une bibliothèque d'objets.

- ***Effet de l'âge sur l'intention B.O***
  B=-.008, t(353)=-3.06, p=.002 ➔ Plus les individus sont âgés moins ils ont l'intention d'emprunter dans une bibliothèque d'objets

- ***La différence de moyennes d'intention d'emprunt pour les objets personnels vs impersonnels est significatif !***
  Les objets personnels (M=.66, SD=.55) ont une intention d'emprunt plus faible que les objets impersonnels (M=.26, SD=.69). Cette différence a été testée grâce à un test t pour échantillons indépendants, qui a révélé une différence significative entre les deux types d'objets, t(754)=8.94, p < .001

➔ ***Objets personnels :*** *Sac de couchage / Tente de camping/ Matelas de camping/ Four à raclette / Appareil à crêpes / Robot de cuisine / Sorbetière/ Deshydrateur alimentaire / Friteuse électrique / Service à fondue au fromage/ Fer à bricelets – Gaufrier / Appareil à panini*

➔ ***Objets impersonnels :*** *Projecteur vidéo / Machine à coudre / Appareil photo / Paire de béquilles / Luge / Réchaud de camping / Bateau gonflable / Sacoche pour vélo/ Remorque pour vélo/ Plaque de cuisson portable/ Perceuse-visseuse / Ponceuse-excentrique / Marteau-perforateur/ Scie onglets / Meuleuse d'angle/ Rabot électrique / Scie sauteuse / Scie circulaire / Enrouleur électrique / Diable à pelle / Escabeau pliant / Nettoyeur à vapeur / Nettoyeur haute pressions / Broyeur végétaux / Taille-haies / Bâche-plastique / Pavillon jardin amovible / Pelle-pioche / Débroussailleuse*

- *Effet du sexe sur l'intention B.O ➔ pas significatif donc ok (p=.625)*
- *Effet du niveau de formation sur l'intention B.O ➔ Anova pas significatif (p=.18)*
- *Effet de la situation sur l'intention B.O ➔ Anova pas significatif (p=.15)*
- Le type de logement n'a pas d'impact sur l'intention d'emprunt des objets. ANOVA $F(2, 348)=2.23$, $p=.110$

Connaissance du questionnaire :

- Support vélo : 2 (0.5%)
- Email : 16 (4.3%)
- Flyer : 25 (6.7%)
- Affichage : 10 (2.7%)
- Tram : 3 (0.8%)
- Réseaux sociaux : 248 (66.7%)
- Par des proches/ amis (Whatsapp etc.) : 60 (16.1%)
- *0 (2.2%) : Entre autres depuis le site de la Manivelle*

Appendix E – Data tables

Number of households in Geneva (Statistique cantonale Genève, 2020)	199,994.00

OBJECT	Survey results							Calculations results		
	№ of households who own at least 1 copy	% of households who own at least 1 copy	% of households who own just 1	% of households who own 2	% of households who own >3	Use per household /year (Median)	Households willingness to borrow object	Annual loans La Manivelle (14 nov 2021-14 nov 2022)	№ of objects if we extrapolate the possesion rate of at least 1 copy to all households in Geneva	№ of households who own this object and would be willing to borrow it
Sleeping bag	293	61.90%	36.70%	39%	24.30%	3	27.80%	67	123,796.29	34,415.37
Raclette machine	273	57.70%	87.60%	10.20%	2.20%	6	72.80%	65	115,396.54	84,008.68
Fondue kit	285	60.30%	83.90%	12.60%	3.50%	5	68.00%	41	120,596.38	82,005.54
Camera	238	50.30%	57.90%	28.10%	14%	12	67.50%	48	100,596.98	67,902.96
Folding step ladder	231	48.80%	83.70%	12.90%	3.30%	15	67.10%	50	97,597.07	65,487.64
Drill-driver	227	48.00%	91.20%	6.60%	2.20%	10	81.70%	333	95,997.12	78,429.65

			Number of households in Geneva (2020)	199,994.00	
	Sharing scenarios based on the survey results and current number of households in the canton				
OBJECT	**№ of households who own at least 1 copy of this object = the № of objects in the canton (at the minimum)**	**% of households willing to borrow object**	**№ of households who own this object and would be willing to borrow it**	**№ of necessary objects if 10 households share 1 object**	**№ of necessary objects if 25 households share 1 object**
Sleeping bag	123,796	28%	34,415	3,442	1,377
Raclette machine	115,397	73%	84,009	8,401	3,360
Fondue kit	120,596	68%	82,006	8,201	3,280
Camera	100,597	68%	67,903	6,790	2,716
Folding step ladder	97,597	67%	65,488	6,549	2,620
Drill-driver	95,997	82%	78,430	7,843	3,137

	Sharing scenario: 1 object per 10 household			
OBJECT	**№ of necessary objects if 10 households share 1 object**	**Total quantity of CO_2e emitted**	**Total quantity of waste produced**	**Total quantity of space occupied**
Sleeping bag (virgin polyester)	3,442	49	3	154
Sleeping bag (recycled polyester)		23		
Raclette machine	8,401	141	39	105
Fondue kit (cast iron)	8,201	60	27	134
Fondue kit (ceramic)		53	24	
Camera	6,790	166	1	1
Folding step ladder (virgin aluminium)	6,549	204	26	73
Folding step ladder (recycled aluminium)		14		
Drill-driver	7,843	184	13	158
Total for the 6 objects	**41,225**	**693**	**108**	**625**

	Sharing scenario: 1 object per 25 household			
OBJECT	**№ of necessary objects if 10 households share 1 object**	**Total quantity of CO_2e emitted**	**Total quantity of waste produced**	**Total quantity of space occupied**
Sleeping bag (virgin polyester)	1,377	20	1	62
Sleeping bag (recycled polyester)		9		
Raclette machine	3,360	56	16	42
Fondue kit (cast iron)	3,280	24	11	53.7
Fondue kit (ceramic)		21	10	
Camera	2,716	66	0.4	0.3
Folding step ladder (virgin aluminium)	2,620	82	10	29
Folding step ladder (recycled aluminium)		6		
Drill-driver	3,137	74	5	63
Total for the 6 objects	**16,490**	**277**	**43**	**250**

	Scenario comparisons for CO_2e emissions							
	Current scenario		Sharing scenario: 1 object per 10 households			Sharing scenario: 1 object per 25 households		
OBJECT	**Current scenario of total CO_2e (in tonnes)**	**Current quantity of CO_2e that can be affected by item-sharing (in tonnes)**	**Quantity of CO_2e emitted (in tonnes)**	**Difference in quantity of CO_2e between sharing-scenario and current scenario = CO_2e savings (in tonnes)**	**Yearly CO_2e avoided (in tonnes) assuming an average object lifespan of 10yrs**	**Quantity of CO_2e emitted (in tonnes)**	**Difference in quantity of CO_2e between sharing-scenario and current scenario = CO_2e avoided (in tonnes)**	**Yearly CO_2e avoided (in tonnes) assuming an average object lifespan of 10yrs**
Sleeping bag (virgin polyester)	1,758	489	49	440	44	20	469	47
Sleeping bag (recycled polyester)	816	227	23	204	20	9	218	22
Raclette machine	1,939	1,411	141	1,270	127	56	1,355	135
Fondue kit (cast iron)	886	602	60	542	54	24	578	58
Fondue kit (ceramic)	781	531	53	478	48	21	510	51
Camera	2,455	1,657	166	1,491	149	66	1,591	159
Folding step ladder (new aluminium)	3,045	2,043	204	1,839	184	82	1,961	196
Folding step ladder (recycled aluminium)	215	144	14	130	13	6	138	14
Drill driver	2,256	1,843	184	1,659	166	74	1,769	177
Total for the 6 objects	**10,399**	**6,929**	**693**	**6,236**	**624**	**277**	**6,652**	**665**

	Scenario comparisons for waste							
	Current scenario		Sharing scenario: 1 object per 10 households			Sharing scenario: 1 object per 25 households		
OBJECT	**Current scenario of total waste (in tonnes)**	**Current quantity of waste that can be affected by item-sharing (in tonnes)**	**Quantity of waste produced in the sharing-scenario**	**Difference in quantity of waste between sharing-scenario and current scenario = waste savings (in tonnes)**	**Yearly waste savings (in tonnes) assuming an average object lifespan of 10yrs**	**Quantity of waste produced in the sharing-scenario**	**Difference in quantity of waste between sharing-scenario and current scenario = waste savings (in tonnes)**	**Yearly waste savings (in tonnes) assuming an average object lifespan of 10yrs**
Sleeping bag	124	34	3	31	3	1	33	3
Raclette machine	542	395	39	355	36	16	379	38
Fondue kit (cast iron)	404	275	27	247	25	11	264	26
Fondue kit (ceramic)	355	242	24	217	22	10	232	23
Camera	13	9	1	8	1	0	8	1
Folding step ladder	390	262	26	236	24	10	251	25
Drill driver	154	125	13	113	11	5	120	12
Total for the 6 objects	**1,603**	**1,084**	**108**	**975**	**98**	**43**	**1,040**	**104**

	Scenario comparisons for space					
	Current scenario		Sharing scenario: 1 object per 10 households		Sharing scenario: 1 object per 25 households	
OBJECT	**Current scenario of total occupied space (in m^3)**	**Current quantity of space that can be affected by item-sharing (in m^3)**	**Quantity of space occupied (in m^3)**	**Difference in quantity of space between sharing-scenario and current scenario = space savings (in m^3)**	**Quantity of space occupied (in m^3)**	**Difference in quantity of space between sharing-scenario and current scenario = space savings (in m^3)**
Sleeping bag	5,542	1,541	154	1,387	62	1,479
Raclette machine	1,445	1,052	105	947	42	1,010
Fondue kit	1,974	1,342	134	1,208	54	1,289
Camera	12	8	1	7	0.3	8
Folding step ladder	1,082	726	73	653	29	697
Drill driver	1,932	1,578	158	1,420	63	1,515
Total for the 6 objects	**11,986**	**6,247**	**625**	**5,622**	**250**	**5,997**