FURNITURE IN THE CIRCULAR ECONOMY – A CASE-STUDY OF FURNITURE-WASTE IN A DANISH DORMITORY

TOBIAS HAUPTMANN

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Aalborg University

AALBORG UNIVERSITY
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Furniture in the Circular Economy –
A Case-Study of Furniture-Waste in a Danish Dormitory

by

Tobias Hauptmann

Declaration of Authorship

Hereby I, Tobias Hauptmann, certify that I wrote the following document: "*Furniture in the Circular Economy – A Case-Study of Furniture-Waste in a Danish Dormitory*" entirely on my own. This submission is my Master Thesis as part for the graduation from Sustainable Design Msc. Engineering at Aalborg University.

Any use of the works of any other author, in any form, is properly referenced and sourced. Information collected by myself through interviews and other methods are referenced as well, for which the respective documents are included in the appendix. Wherever I received any form of help for translations or feedback to my work, it is stated so. No part of this thesis has previously been submitted for a degree or any other qualification at Aalborg University or any other institution.
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Date: 4th of June 2020 (04/06/2020)

Abstract

Investigating furniture-waste in a Danish dormitory for students, while analyzing this from a Circular Economy perspective, was the research objective of this thesis. The main research question was:

> '*What are the influential factors that make furniture become waste*
> *and how do they need to change to implement a circular solution*
> *in a Danish dormitory environment?'*

It revealed that at the case-study, *Danmarks Internationale Kollegium* (DIK), furniture is a disposable product. Observations and photographic documentation revealed that not only furniture is disposed when tenants move out of this student housing, but several other products as well. Different discarding practices can lead to reuse, e.g. by using the local online-platform, but long-term storage is not possible, due to a lack of staff, rather than a lack of space and to fulfill fire-regulations.

Interviews and a survey showed that the biggest driver by several stakeholders for purchases of new or used furniture was price, which also challenges maintenance, storage and repair activities, as labor-costs exceed the low price of new products, making them economically obsolete. Reuse is commonly practiced by tenants, but is challenged by hygienic concerns, specifically an infection with bedbugs. Furniture doesn't become waste because of one single reason, but due to the sum of different interlinked and complementary problems.

The waste-management locally and for the whole sector has shown to be nontransparent as little reliable data on waste are available, but indicates that the majority of furniture is incinerated. Repair, reuse, remanufacturing and other circular businesses are statistically not measured or have a small share in this sector, which is defined by the linear economy model.

The main achievement of this research is to document a problem that remains hidden in statistics and is not acknowledged by the local housing organization. Consequently a strategy for implementing different solutions was developed how the linear consumption of furniture can turn to a circular usage at this dorm. Nonetheless, without the implementation of any mandatory political instruments, it is very unlikely that these will come in effect and that the current disposable character of furniture will change anytime soon.

Key Words:

Furniture, Furniture-waste, Circular Economy, Obsolescence, Waste-hierarchy, Student Dormitory (Dorm)

Disclaimer

Disclaimer from Head of Studies and Head of Study Boards

COVID19 and the consequences of the lock-down of society and the university since March 13, 2020 have had influence on which activities that have been possible to stage and carry out as part of the project work.
When assessing this project, please bear this in mind.

Personal Disclaimer

The lock-down due to COVID19 influenced my thesis as follows:
Even though most of the interviews were conducted before the lock-down, a few requested interviews were not held at all or only via Email. The ones not held at all, were rather challenged as the desired interviewees were not able or willing to answer. The survey was conducted during the lock-down online, of which the positive or negative influence on the low level of participation have not become clear. Therefore the primary research itself didn't seem to be heavily impacted by the lock-down.

But more importantly, the desk research, analyzing data and writing texts was strongly impacted. Due to the lock-down all public spaces were closed, including libraries, cafés etc. that would have allowed to have an alternative study place. Consequently all writing, reading etc. was done at the private residence, which is one small dormitory room with no place of retreat. This is the opposite of a good learning and writing environment, as one is constantly surrounded by various noises of other people talking, playing music, cooking, maintenance work, construction work etc., hence disturbances were always there. The permanent presence in the living and learning environment in addition to finish the thesis under these circumstances within the deadline was psychologically and emotionally extremely stressful which caused anxiety, panic attacks and further physiological stress symptoms.
These were the research conditions that should be considered when assessing this project.

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Abbreviation List

(in order of appearance)

Circular Economy – **CE**
European Commission – **EC**
Extended Producer Responsibility – **EPR**
European Union – **EU**
Small and Medium Size Enterprise – **SME**
Circular Business Model – **CBM**
European Federation of Furniture Manufacturers – **UEA**
European Furniture Industries Confederation – **EFIC**
Danmarks Internationale Kollegium – **DIK**
Research Question – **RQ**
Appendix – **App.**
Eco-Design – **ED**
Circular Product Design – **CPD**
Product Service System – **PSS**
Student Housing Organization – **SHO**
Facebook – **FB**
Ellen MacArthur Foundation – **EMAF**
United Kingdom – **UK**
Furniture Reuse Network – **FRN**
Household Waste Recycling Centers – **HWRC**
Den Bla Avis – **DBA**
Green Public Procurement – **GPP**
Green Furniture Market – **GFM**
Life Cycle Assessment – **LCA**
Kollegiernes Kontor I Kobenhavn – **KKIK**
Albertslund Genbrugsstation – **AGS**
Aalborg University Accommodation Office – **AUAO**
Agenda Center Albertslund – **ACA**

other terms:
circular: adjective used to describe when something is done in accordance with the
Circular Economy principles, design-strategies or business-models
linear: adjective used to describe when something is done in accordance with the
Linear Economy

1. Introduction

Employment, education and changing lifestyles make people move more so they become nomadic (Hennessey & Papanek 2008), today on a global scale. Nonetheless people need furniture to fulfill their living needs, even when settling only temporarily. Either by transporting it or by purchasing at their new home, for which they become consumers in an industrialized economy.

1.1 The Linear Economy

While society moves on an ever increasing pace, industrialized economy has not yet moved beyond a linear model of resource consumption following a 'take-make-dispose' pattern (EMAF 2013). Specifically, in the linear economy, companies extract materials, from which they manufacture products, which are sold to consumers, who use the product and discard it when no longer considered useful. This system is associated with an immense resource loss, illustrated by the fact that Europe generated 2.7 bil. tons of waste in 2010 of which only 40% were reused, recylced or composted. Increasing population and urbanization will lead to an increasing demand and prices for resources, too, therefore wastefulness should be avoided long-term (EMAF 2013).

Even though this research didn't investigate how furniture reached it's current status of being disposable products, overcoming the linear economy should be in interest of everybody, which parts of the furniture industry strive for (EFIC 2020).

1.2 The Circular Economy

Circular Economy (CE) is a concept or industrial model, that intends to decouple economic wealth from resource usage (Bakker et al. 2015) or material input, as an alternative to the linear economy (Arpin et al. 2015). The goal is to provide products and services, while keeping the value embedded in the products, components and it's used materials at the maximum (Medkova et al. 2016) (EMAF 2015).
It's restorative and regenerative design (EMAF 2015) minimizes the use of primary raw materials (Medkova et al. 2016), moving away from resource-waste and instead closes material loops, ideally to 'design out waste', where "*today's goods are tomorrow's resources*" (EMAF 2013, 2).

1.3 European Commission's Waste Directive

The Waste Framework Directive, 2008/98/EC is an obligatory framework from the European Commission (EC) for the development of management plans for the handling of waste in the community (EC 2008). It provides central definitions, and lays down measures with the goal to protect the environment and human health by preventing or reducing waste through a waste-hierarchy. It was developed according to the *Polluter Pays Principle*, where the costs of disposing the waste must be covered by the producer, the previous holder of the product or the holder of the waste. It also introduces the *Extended Producer Responsibility* (EPR) (EC 2008).
EC defines waste as "*any substance or object which the holder discards or intends or is required to discard*" (EC 2008, 312/9). Accordingly, a product, reaches the status of waste

as soon as it is discarded or not in ownership of the holder anymore.
Whereas Korhonen et al. (2018) state the concept of waste is culturally and societal dependent, therefore the moment when a material becomes waste, which has no or only economic value, is difficult to define.

The waste-hierarchy provides the following priority of actions to handle or prevent waste (EC 2008, 312/10):
"*(a) prevention;*
(b) preparing for re-use;
(c) recycling;
(d) other recovery
(e) disposal."

Figure 1.1: Waste Hierarchy (EC 2019a)

Prevention is described as measures that are taken before the product, material or substance becomes waste by reducing it's quantity, the adverse impact on the environment and content of harmful substances. Reuse means any measurement through which products or components are used again for the same purpose and thereby are not waste (EC 2008).

Preparing includes operations as checking, cleaning and repairing, which recovers products or components from the waste-status so they can be reused (EC 2008).

Recycling are recovery operations that reprocesses waste-materials into products, materials or substances of the same or different purpose, not including any kind of energy recovery or backfilling. Improving recovery potential can be achieved by collecting waste separately (EC 2008).
But it should be kept in mind that recycling should create a product with equivalent properties as the source material (Bocken et al. 2016).
Whereas *Downcycling* or secondary recycling is mechanical reprocessing, that presents a downgrade in the material quality or lowering in value, which consequently limits the usability (Bocken et al. 2016) (EMAF 2013). *Upcycling* intends to retain or improve the properties of the material and increase it's functionality (Bocken et al. 2016) (EMAF 2013). Hence the order of recycling activities should be upcycling, recycling and downcycling.

The directive is quite vague about the term recovery, as this is any operation, where waste is serving a useful purpose by replacing other materials. Incineration of solid waste must be energy-efficient and is considered a recovery operation, although a recycling society should not support incineration or landfilling (EC 2008). Energy recovery is also described as *thermal* or *Quaternary recycling* (Bocken et al. 2016), as it converts non-recyclable materials into useable heat, electricity or fuel (EMAF 2013).
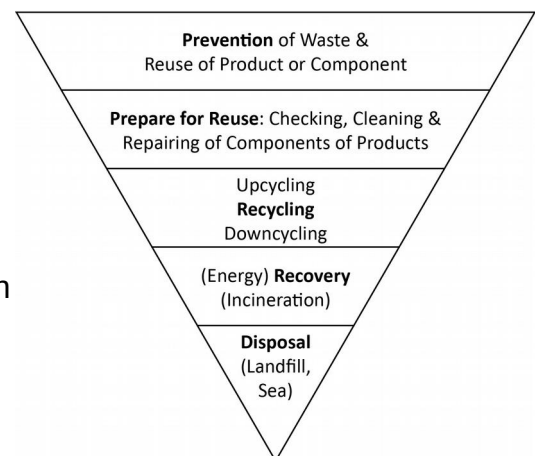
Disposal is any operation that doesn't recover materials, but has a secondary consequence. A list of disposal operations is landfill, release to sea or ocean and incineration on land (EC 2008). As the disposal of a product in a landfill indicates the

Figure 1.2: Waste Hierarchy based on (EC 2019a) (EMAF 2013) (Bocken et al. 2016)

residual energy is lost, it should be avoided (EMAF 2013).

Consequently a more refined visualization of the waste-hierarchy is presented (see figure 1.2).

1.4 Obsolescence

Product Obsolescence is described as the premature shortening of a product's time in use. For example when it's not functional, desired (Penty 2020b) or considered useful anymore, a state which can be reversed (den Hollander et al. 2017).

Aesthetic Obsolescence relates to a product's visual appearance. Either a product can aesthetically appear worn out, so the newness has worn off due to usage related wear and tear. Or *Fashion Obsolescence* makes a product aesthetically obsolete when it's out of fashion or style (Burns 2010), which is triggered by trends that encourage consumers to upgrade the style with a new product. This can be mitigated by enabling product to refresh the aesthetic without new material input (EMAF 2013).

Material Obsolescence (Penty 2020b) or *'weakest link' component* (EMAF 2013) describes the failure or breakage of one component, due to the poor design, low quality or vulnerability. Since it often cannot be repaired or spare-parts are unavailable, the entire product is discarded (Penty 2020b).

Technological Obsolescence appears when a newer product based on technological changes makes the functioning product obsolete (Burns 2010), which is also described as *functional obsolescence* (Penty 2020b).

Economic Obsolescence occurs when the product's repair (Penty 2020b), maintenance, reuse, upgrade (Burns 2010) or transport for the consumers or manufacturers outweighs the cost of buying a new product (EMAF 2013). As human labor is costly (in western Europe) recovering products is abandoned due to the presence of cheaper, new alternatives, which are difficult to maintain etc., such as sofas (Burns 2010).

Legal Obsolescence can occur when the legal liability of a product from a cooperation vanishes, e.g. a warranty (EMAF 2013), or when laws or standards become effective and make products obsolete according to Burns (2010), which he refers to as *Social Obsolescence*.

Other types of obsolescence are *logistical* (den Hollander et al. 2017), *systemic* (Medkova et al. 2016), *psychological* and *planned obsolescence* (Penty 2020b).

1.5 Overview Furniture Industry

The furniture industry of the European Union (EU) has a turnover of 96 bil. €, which represents 25% of the world furniture production and consumption (EFIC 2019).
The EU 28 consumes ca. 10.5 mil. t. of furniture per annum (Forrest et al. 2017), or ca. 20.5 kg per capita (Eurostat 2020) of which 82% is domestic and 18% business to business (Forrest et al. 2017).

This industry is considered resource and labor-intensive (Renda et al. 2014) and employs ca 1,08 mil. people in 2010 (JRC 2013). They work in ca. 120 000 (EFIC 2019) to 130 000 companies (JRC 2013), such as local craft-based firms or large volume producers (Renda et al. 2014).
However, a vast majority of these companies are small and medium size enterprises (SMEs) (Forrest et al. 2017) with less 250 employees and 85% employ less than 10 people (Renda et al. 2014). Even though they are accounted for ca. 70% of the sector's production (Renda et al. 2014), SMEs are associated with a lack of finance for necessary expertise and infrastructure to adopt circular business models (CBM) (Forrest et al. 2017).

Whereas, market giants as IKEA or JYSK, make up only 0.4% of the European Companies, but generate 27% of it's production value (Renda et al. 2014, 63). The IKEA group is the world's largest furniture retailer with a total sales volume of 24.7 bil. € in 2011, of which 79% were produced in Europe (JRC 2013).
The furniture market has high concentration in retailing and an increase of large scale distributors are reported, as the 15 biggest companies had a market share of 24% in 2007, which grew to 30% by 2010. These leading players are gaining competitive advantage by optimizing manufacturing, shipping furniture in large quantities, outsourcing into low-wage countries, rationalization and downsizing strategies and fragmenting their production (Renda et al. 2014).

There are two central industry organizations: the European Federation of Furniture Manufacturers (UEA), as well as the European Furniture Industries Confederation (EFIC), of which the UEA doesn't produce publicly available reports, in contrast to EFIC, who published it's Circular Economy Action Plan (EFIC 2020) and other papers.

1.6 Reading Guide and Research Questions

The topic of this thesis was chosen because the author previously lived in in the research environment, student dorm Danmarks Internationale Kollegium (DIK), in Albertslund (Denmark), and therefore became aware the problem of furniture-waste.
The structure of the thesis deviates from conventional scientific papers, as the introduction only contains a small part of the literature review. The theoretical framework is explained before the main share of the literature review, as the later utilizes the theoretical vocabulary. Afterwards the primary data are analyzed, summarized and case-specific solutions suggested, as well as necessary changes for the furniture sector to become circular are presented. All documentation charts on which charts used in the text build up, some images used and graphics created can be found in the appendix.

The research questions (RQ) for the thesis are:
Main RQ:
What are the influential factors that make furniture become waste and how do they need to change to implement a circular solution in a Danish dormitory environment?

Sub-RQ:
1) How linear or circular is the furniture industry and their products?
2) How much furniture-waste is created at DIK and how is it handled?
3) Which circular furniture-design solution(s) could reduce the amount of waste at the dorm?

2. Theoretical Framework

2.1 The Concept of Circular Economy

<u>Technological and Biological Cycle</u>

The CE differentiates between the *Biological Cycle*, in which *Biological Nutrients* are biodegraded (Braungart et al. 2003), which are applied in *products of consumption* (Bocken et al. 2016).
And the *Technical Cycle* in which *Technical Nutrients* like products and materials cycle (Braungart et al. 2003), consisting of man-made materials as alloys and plastics. These are applied in durable goods (EMAF 2013) or *products of service* (Bocken et al. 2016), made for use, instead of consumption. Since furniture is a durable good, the focus will be on the technical cycle, which is not unusual from a product design perspective (Bakker et al. 2015).

<u>Slowing, Narrowing and Closing the Loop</u>

The terminology in CE of "*slowing, closing and narrowing*" of resource cycles or loops was introduced by Bocken et al. (2016, 309).

Slowing the resource loop is concerned about "*design of long-life goods and product-life extension*" (Bocken et al. 2016, 309) so to prolong or intensify use and reuse of products or goods.

Closing the resource loop is about reuse of components or materials, e.g. through recycling in the respective cycles, between post-use and manufacturing (Bocken et al. 2016).

Figure 2.1: Categorization of linear and circular approaches for reducing resource use (Bocken et al. 2016, 309)

Narrowing the resource loops is about reducing resource use of a good in the production, which is set similar to resource-efficiency. Since this strategy is not concerned about the pace of resource flows or recapturing embedded resources, it can't be considered a CE strategy on it's own, only coupled with the other two strategies (Bocken et al. 2016, 309).

<u>Value Cycles in the Technical Cycle</u>

Several authors point out or formulate different cycles or loops to create or maintain value, which will be referred to as "*Value Cycles"* (EMAF 2013, 73), for which the different terms are summarized in table 2.1.

A prolonged use phase is associated with actions as maintenance, which can be described as all aspects connected to deliver a performance as long as possible (Bakker et al. 2015) and keeping a product in a workable state, as well as repair or cleaning (Arpin et al. 2015). This phase will be referred to as *Longer Use of Products*.

Value Cycle / Author	Longer Use of Products	Reuse of Products	Refurbishment and Remanufacture of Components	Recycle of Materials
Bakker et al. 2015,	Future proof & Maintenance	Reuse of products	Remake, prolonged use or reuse of components, includes refurbishment, remanufacturing and reconditioning	Reycling, material recovery, reuse of material
Medkova et al. 2016, 3	design for longevity	design for leasing or service, Reuse	design for re-use in manufacture, repair, remanufacture, refurbishment	design for material recovery
EMAF 2015, 50 EMAF 2013, 7	Maintenance	Reuse/ Redistribute	Refurbish/ Remanufacture	Recycle
Arpin et al. 2015, 36	Product maintenance	Product reuse /redistribution	Product refurbishment/ remanufacture	Product recycling

Table 2.1: Overview chart - Different Terminologies for Value Cycles based on literature review (created by author)

The value cycle *Reuse of Products* adapts the terminology of Bakker et al. (2015), and is concerned about bringing goods back into a use-cycle of the same purpose with little changes as possible (EMAF 2013), which also requires redistribution or services in general (Arpin et al. 2015).

Refurbishment and Remanufacture of Components is the value cycle concerned with the reclaiming (Medkova et al. 2016), refurbishing or reconditioning and thereby the prolonged use of parts or components of products (Bakker et al. 2015). Refurbishment is about exchanging or repairing broken components (Medkova et al. 2016) or updating the appearance of a product, and remanufacturing is about disassembling products, reclaiming components and reassembling them into new products (EMAF 2013).

Recycle of Materials is a process of recovering materials (EMAF 2013) at their end-of-live respectively capturing remaining value (Bakker et al. 2015). It is seen as the last, but mandatory, option within CE and the process depends on the ability to separate materials (Bakker et al. 2015).

These different value cycles are summarized in figure 2.2.

The inner *v*alue cycle or tightest possible loop (Arpin et al. 2015) should be the most preferred option, closer to the user (Medkova et al. 2016), as it keeps value high and saves input of energy, labor or money going into the subsequent actions (EMAF 2013).
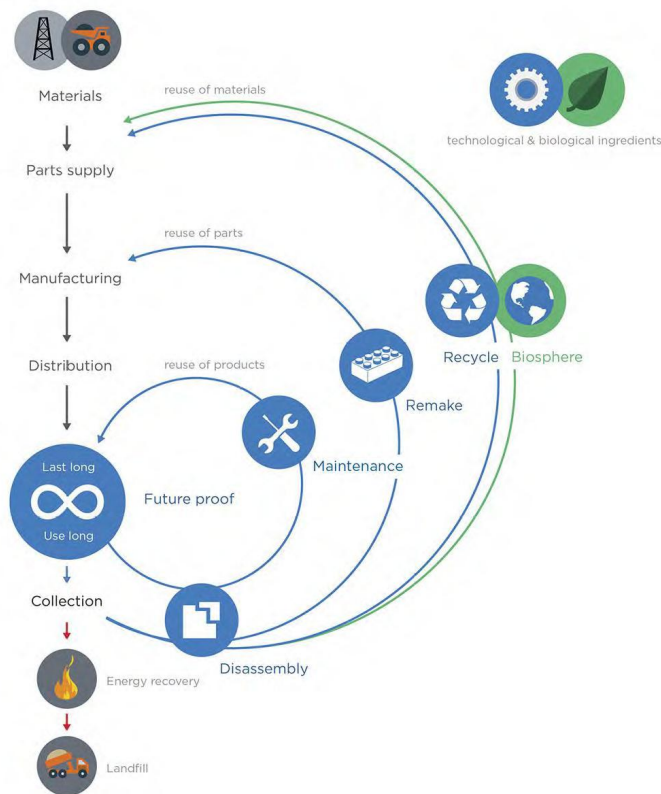
Figure 2.2: Circular product design model (Bakker et al. 2015, 367)

2.2 Circular Design Strategies

2.2.1 Circular Product Design

Product Design-strategies in the CE are necessary to understand and determine the optimal product life scenario (Bakker et al. 2014).
Literature differentiates between *Eco-Design* (ED) and *Circular Product Design* (CPD). *ED* is considered product design, which systematically integrates environmental performance and orients itself on the waste-hierarchy of the EC. Whereas CPD follows the principle of CE, in which waste is non-existent (den Hollander et al. 2017).

Product Lifetime or *Lifespan* is a key concept of the CE, which is central to extend product life (den Hollander et al. 2017) (Bakker et al. 2014). A product lifetime describes the period of a product being released from manufacturing for use and ends when a product or it's components can't be recovered from obsolescence. Whereas a *Product Use Cycle* is a period when a product is released for use from manufacturing or recovery and finishes when the product becomes obsolete, which can be reversed. It is important to make this distinction since a product can only have one *Lifetime*, but several *Use Cycles* (den Hollander et al. 2017).

2.2.2 The different Circular Product Design Strategies

The design-strategies reviewed are categorized according to the previously defined value cycles.

<u>2.2.2.1 Longer Use of Product</u>

<u>Design for Physical Durability</u>

Design for Physical Durability is about making physically and functionally longer lasting products (Bakker et al. 2015), so they become resilient to tear and wear (Medkova et al. 2016), fatigue, corrosion and damage, don't break easily (Franco 2019), hence being used or perform longer without failure.
This strategy slows the loop and resists obsolescence (den Hollander et al. 2017).
It is influenced by the choice of materials (Bocken et al. 2016) and the design of product and components (den Hollander et al. 2017).

<u>Design for Emotional Durability</u>

Design for Emotional Durability has the goal to create an emotional attachment of the user with the product, so it will be loved, trusted (Bocken et al. 2016) and not disposed prematurely and unthoughtful, e.g. as it carries memories or is personalized (Van Nes et al. 2005). This aspect is difficult to influence by designers (den Hollander et al. 2017).

<u>2.2.2.2 Extended Use of Products</u>

<u>Design for Maintenance</u>

Maintenance is a preventive task, to retain the aesthetic, functional or hygienic condition of a product, e.g through inspection, adjusting settings, cleaning and removing foreign elements, as well as exchanging consumables of a product that are required for normal operation, e.g. vacuum cleaner bags (den Hollander et al. 2017) (Bocken et al. 2016).
This should be easy to perform (Medkova et al. 2016) and avoid a product failure in the future to keep it in a workable condition (Bakker et al. 2015), hence extending use.

<u>Design for Repair and Refurbishment</u>

Design for Repair and Refurbishment intends to restore a product's condition from a malfunctioning, damaged or obsolete state (Bakker et al. 2014).
Repair is the corrective maintenance of specific faults (den Hollander et al. 2017) or damages, such as exchanging broken components of a product, restoring it to a sound or good condition (Bocken et al. 2016), which also requires anticipating possible failures by the designers (Bakker et al. 2015). The repair should be so easy to perform, that the users themselves can do it (*Design for Self-Repair*) (Van Nes et al. 2005).

<u>Design for Upgrade & Adaptability</u>

Design for Upgrade & Adaptability requires a product design that allows a future expansion and modification for possibly changed conditions (Bocken et al. 2016) or user needs (Medkova et al. 2016), to enhance the capabilities of the product, which is still in working condition and should remain useful.

<u>Design For Modularity & Standardization</u>

Design for Modularity & Standardization is a strategy to fight against systemic obsolescence (Medkova et al. 2016) by designing products in a way that it consists of separate, exchangeable and standardized modules, which allow replacing only necessary components instead of the whole product, e.g. providing a long-lasting product-skeleton (EMAF 2013). Therefore it can increase the reuse rate of components, which requires design for dis- and re-assembly so the parts can be separated (Bocken et al. 2016). It can provide customization or personification of the product, enables upgrading, adaptation (Van Nes et al. 2005), as well as easier repair, maintenance and remanufacturing tasks (Bakker et al. 2015).

<u>Design for Dis- and Reassembly</u>

Design for Dis- and Reassembly is a strategy that allows non-destructive separation of components and materials (Bakker et al. 2015), which ensures that a product can easily and efficiently dis- an re-assembled, e.g by using flexible mounting techniques (EMAF 2013). The degree to which parts and materials can be separated will influence the ability to recycle, remanufacture or maintain the product (Franco 2019).

<u>2.2.2.3 Design for Remanufacturing of Components</u>

Design for Remanufacturing of Components is a strategy to slow the loop and prolong the use of product-components (Bakker et al. 2015), when the product returns from the consumer to the manufacturer, and reclaims these through a "*series of industrial processes in a factory environment*" (den Hollander et al. 2017, 523).
The obsolete product is disassembled into components, were the functioning parts are reclaimed and eventually reused in a remanufactured product (den Hollander et al. 2017). This requires reverse logistics and transportation, e.g through design-criteria, that allow efficient and space-saving transport (Bakker et al. 2015).

<u>2.2.2.4 Design for Recycling of Materials</u>

Design for Recycling of Materials is a design-strategy to close material loops to reclaim resources at the end of product life (Bakker et al. 2015). It requires separating the materials, biological and technological nutrients (EMAF 2013), which is influenced by the choice of materials, as well as the degree of disassembly, the product design and material flows and collection schemes that allow reduced contamination. The more it has been designed for disassembly and the fewer materials are used in the product, the less time and work is required to separate the materials, which then increases the amount of recycled materials (Franco 2019).

<u>2.2.2.5 Other Design Strategies and Criteria</u>

Other design-criteria that contribute to slow or narrow the loop mentioned are *Dematerialisation* (Mestre & Cooper 2017) or *material-efficiency* (Bakker et al. 2014), *timeless design* and *minimized product volume* (Bakker et al. 2015) amongst others.

Table 2.2 is summarizing the possible CE design-strategies.

Longer Use of Products	Extended Use of Products	Remanufacturing of Components	Recycle of Materials
Design for Physical Durability Design for Emotional Durability	Design for Maintenance Design for Upgrade & Adaptability Design for Recontextualization Design for Repair/Self-Repair and Refurbishment Design For Modularity & Standardization Design for Disassembly and Reassembly	Design for Remanufacturing of Components Design For Modularity & Standardization Design for Disassembly and Reassembly	Design for Recycling of Materials Design for Disassembly and Reassembly

Table 2.2: Overview Chart of the different Product Design-Strategies according to the Value Cycles (created by author)

Accordingly a new scheme was developed summarizing the different value cycles and respective design-strategies (see figure 2.3) based on the scheme by Bakker et al. (2015).
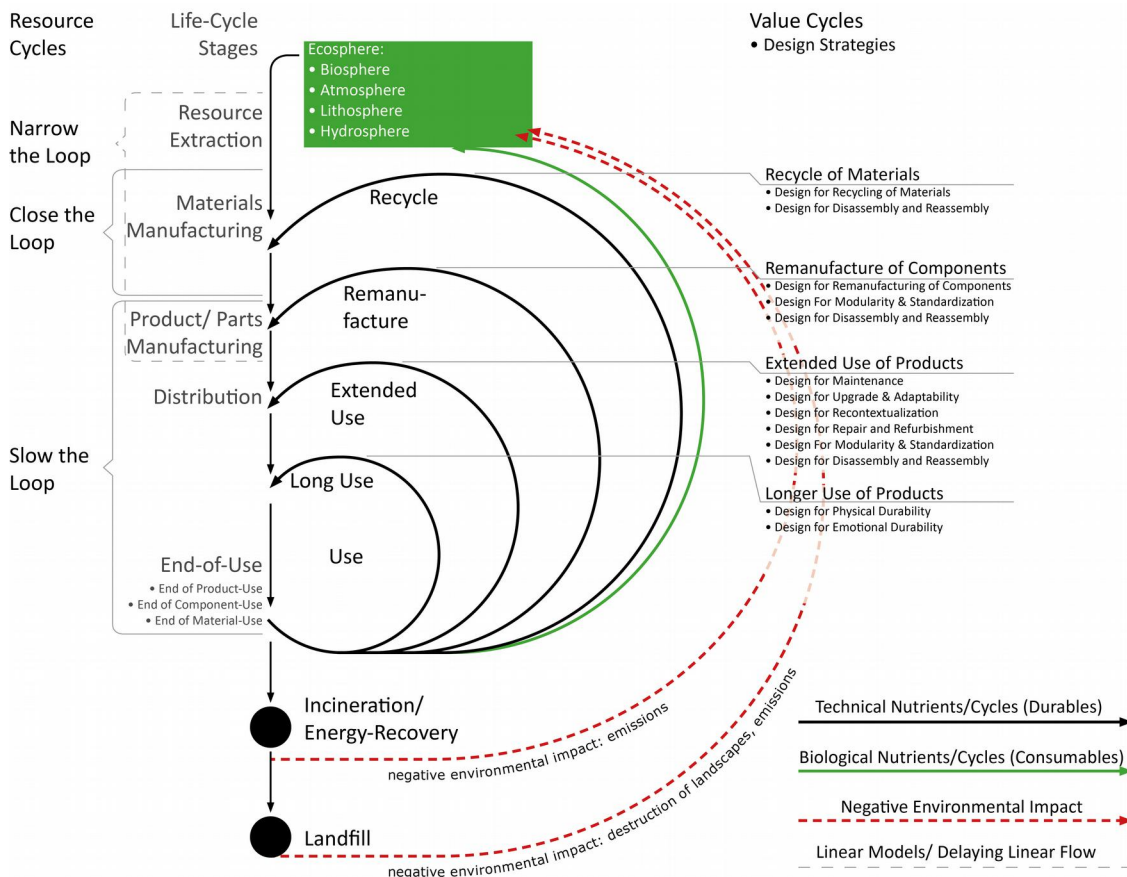
Figure 2.3: Adapted Circular Economy Model Value Cycles and Design-Strategies based on literature review (graphic created by author)

2.3 Circular Business Models

2.3.1 What is a Circular Business Model?

A Circular Business Model (CBM) can be understood as the architecture or the way a firm does business, by creating, delivering and capturing value through coupling their actions with circular design strategies (Bocken et al. 2016). The goal should ideally be to extend the useful life of products and close material loops at the end-of-life, while capitalizing on the embedded economic value (Nußholz 2017) and still delivering environmental and social sustainability in the industrial system (Bocken et al. 2014).

2.3.2 Categorization & Different Business Models

The reviewed literature didn't provide a consistent categorization of CBMs, therefore they were categorized according to the value cycles and life-phases of a product. They are summarized in table 2.3, but not all of them will be elaborated here.

2.3.2.2 Longer Use

Classic long life is a CBM that aims to provide goods with a long product-life through high quality, durable, repairable and long-lasting design, to slowdown replacement cycles and avoid premature disposal (Bocken et al. 2014). These CBMs produce high-priced or premium products and could be supported with activities as repair services or enable reuse (Bocken et al. 2016).

Encourage Sufficiency is a CBM which provides solutions that actively seeks to reduce consumption by providing fewer, but qualitative high-end products and position themselves against ocerconsumption and built-in obsolescence, like furniture producer *Vitsœ* (Bocken et al. 2016).

2.3.2.3 Intensified Use

Sharing is a CBM that enables sharing the functionality, use, access or ownership of products between multiple people (Moreno et al. 2016) (Bocken et al. 2014). Collaborative consumption in the *Sharing Economy* can occur for example for household devices, as laundry services, through *Sharing platforms* between private members of a local community and businesses (Lewandowski 2016) (Korhonen et al. 2018).

The *Access and Performance* model or *Product Service System* (PSS), gives the user access to the functionality or capability of a product without physical ownership (Bocken et al. 2016) (Bocken et al. 2014). Users benefit as they have access to the performance of a service or product, while the maintenance tasks are done by the manufacturer or retailer. The business profits when the product is coupled with relevant design-strategies as durability, repairability or energy-efficiency (Bocken et al. 2016).

The goal is to potentially reduce the overall need for physical goods (Bocken et al. 2016) and through that contribute to a dematerialized economy, which can decouple economic growth from material consumption (Franco 2019).
There are three types of a PSS:
For a *result-oriented* or *performance-based* PSS, the customer pays for the delivered

result, solution or effect, like a pay per print from photocopier services (Bocken et al. 2014) (Lewandowski 2016).
A *use-oriented* or *availability-based* PSS, like car-sharing, gives a customer access to a service or product for a specific time-period (Bocken et al. 2014) (Lewandowski 2016).
A *product-oriented* PSS or *product lease* gives access to a product without being the physical owner (Lewandowski 2016).

Challenges of a PSS could be customer-product relationship, as it requires changed consumption patterns (Bocken et al. 2014), customers might have hygienic and safety concerns , and an excessive or improper use might shorten the product's life, as it often occurs when customers do not own the product (Franco 2019).

2.3.2.4 Extending product value

Extending product value are CBMs that fit the value cycles *Extended Product Use,* where the remaining value of a manufacturer's, retailer's or brand's product is exploited by themselves or a third party (Bocken et al. 2016).
They can encompass several initiatives to deliver customers an affordable product in an 'as new condition', through remanufacturing or repair, through life extension strategies, but also through online-platforms, like ebay that enable a reuse (Bocken et al. 2016). Since these CBMs enable several use phases and levels of value creation (Nußholz 2017), it also requires take-back-systems, reverse logistics and collaborations, that enable product return (Wells & Seitz 2005).

2.3.2.5 Extending resource value

Extending resource value is a CBM to close the loop, to collect, sort and reuse materials and resources that previously were considered waste, as they have been used and disposed (Bocken et al. 2016). The benefits of recycling are considered to be a reduced demand for new resources through primary extraction and reduced waste to landfills and emissions, which has the potential (Bocken et al. 2014).

2.3.2.6 Others

Re-purpose the business for society/environment deals with delivering social and environmental benefits, which are prioritized over economic profit maximization. For example *Non-profit Organizations* condition a social mission and positive societal externalities, without the need to make profit. Nonetheless they need to be funded, which is often based on external donations and challenges to remain long-term economically viable (Bocken et al. 2014).

Consequently, it is necessary to match the given strategies with the research context, product category and business-model (Bakker et al. 2014).

Value Cycle/ Life Phase	Circular Business Model	Sub-Circular Business Model	Authors
Manufacturing	Efficiency	Lean Manufacturing	(Lewandowski 2016) (Bocken et al. 2014) (Nußholz 2017) (Bocken et al. 2016) (Wells & Seitz 2005) (Moreno et al. 2016)
		Industrial Symbiosis	
		Frugal Business Model	
		Others	
	Substitute with renewables and natural processes	Replacing renewable materials with non-renewables	(Bocken et al. 2014) (Bocken et al. 2016)
		Use of local, renewable energy	
		Environmentally friendly production processes	
Longer Use of Products	Classic long life		(Bocken et al. 2014) (Bocken et al. 2016)
	Encourage Sufficiency		
Intensified Use	Shared Use	Shared Use	(Bocken et al. 2016) (Franco 2019) (Bocken et al. 2014) (Korhonen et al. 2018) (Moreno et al. 2016) (Lewandowski 2016)
		Leasing	
	Access and Performance or Product Service System	Result-oriented PSS	
		Use-oriented PSS	
		Product-Oriented PSS	
Extended Use of Product Reuse of Components	Extending Product value	Reuse	(Bocken et al. 2014) (Bocken et al. 2016) (Nußholz 2017) (Wells & Seitz 2005) (Moreno et al. 2016)
		Repair	
		Remanufacturing	
Recycle of Materials	Extend Resource Value	Recycling	(Bockenet al. 2014) (Bocken et al. 2016) (Nußholz 2017) (Wells & Seitz 2005) (Moreno et al. 2016)
Others	Adopt a Stewardship Role	Upstream Stewardship	(Bocken et al. 2014) (Lewandowski 2016)
		Downstream Stewardship	
	Re-purpose the business for society/environment	Social Enterprises	
		Non-profit Organizations	
		'Hybrid' business model	
		Develop scale-up solutions	
	Dematerialized Services		

Table 2.3: Overview Chart of Circular Business Models based on literature review (created by author)

2.4 Lock-Ins

Sustainable development and long-term global sustainability is challenged by societal decisions, which can create path-dependencies and lock-ins (Korhonen et al. 2018), which are self-reinforcing barriers for change (Unruh 2002).

The concept of carbon lock-in was developed by Unruh (2000), to explain how energy

systems in industrial economies are locked into fossil fuel-based technology. They created path-dependencies through a coevolutionary process between technological infrastructures, organizations, society and governing institutions that hinders the diffusion of carbon-saving technologies (Unruh 2002).

Accordingly, there are five sources of lock-ins: *Technological*, meaning a dominant design and standard technological architecture; *Organizational Routines*, such as training or customer-supplier relations; *Industrial*, like industry standards and technological inter-relatedness; *Societal*, through adaptation of preferences and expectations or system socialization; and *Institutional,* such as governmental policy interventions and legal frameworks (Unruh 2002, 318).

He evaluated three generic policy approaches that disrupt the existing technological systems. *End-of-pipe* solutions make no change to the system or infrastructure but only treat emissions on the output side, e.g. add-on technologies. *Continuity* approaches are alternative solutions, which modify selected components or processes, but leave the overall system architecture intact, therefore present incremental change. Whereas *Discontinuity* intends to replace systems entirely through political efforts that lead to radical changes and a transition to a superior system (Unruh 2002, 318-19).

Waste infrastructures could lead to lock-in situations over time, therefore sustainable urban infrastructures should be adaptable and open in design (Zapata et al. 2014). A lock-in at lower levels of the waste-hierarchy should be prevented (EC 2018).

3. Research Design & Methodologies

3.1 Research Design & Literature Review

For the research, the author was using a mix of qualitative and quantitative methods, as they were seen as complementary or mutually illuminating (Bryman 2012). The research-design was constructed, so continuous field research provides the basis for the application of quantitative methods, as the suggested by Miles and Huberman (1994 in Flick 2009; see figure 3.1).

Figure 3.1: Research Designs for the Integration of Qualitative and Quantitative Research (Flick 2009, 26)

In detail, that means field research, observations of disposal behavior and documentation of furniture-waste lead to identifying stakeholders to interview and content of the survey. Observations were not affected by the conditions mentioned in the disclaimer and most interviews were held beforehand. The research design is illustrated in figure 3.2.

Desk research by searching, collecting and reviewing literature, was conducted approximately twice as much as primary research. It encompasses a review of CE and it's strategies and business-models allowed to construct a theoretical framework, followed by circular solutions in the furniture sector, the problems in the furniture industry and their products. For the specific topic of furniture-waste in dormitory environments, scientific or grey literature was not found, so internet articles were used as a source.

Figure 3.2: Visualization of the Research Design (Graphic Created by Author)

The prioritization of literature was first scientific articles, second grey literature as reports handed out by private organizations, and third online articles, when no other sources were available.

3.2 Semi-Structured Interviews

Semi-Structured or semi-standardized interviews were held with people employed in the research field: the dormitory, sustainability experts and people handling furniture-waste. These staff members can be considered experts as they either hold professional experience and practical knowledge or have specific, systematized and reflexive knowledge (Flick 2009). In total five semi-structured interviews were held (Appendix (App.) 4-5, 13-15).

They were held to gain complementary, specific information on previously made observations, auto-ethnographic experience from the author or gain insights into an unknown field, therefore were theory-driven questions (Flick 2009), starting with "*How many*" and "*What kind of*" to gather facts.
On the other hand, the goal was to understand the perspective and attitude of the interviewee and the represented organization towards certain topics (Mack et al. 2005). Open questions (Flick 2009) like "*Does … see furniture-waste as a problem?*" and "*Why*" helped to comprehend the reasoning, mechanisms and motivations behind the facts.
A question-catalog was used as an interview-guide, which was given to the interviewee beforehand if possible, but the interviewee was given the chance to elaborate as desired or introduce new topics (Flick 2009).
The biggest challenge before and during the interviews were the language barrier between the interview-partners, as the common basis was English, which was no one's native tongue. This was once supported through translations of questions by a friend and during another interview verbally by Signe Landon (App.14).

3.3 Unstructured Interviews

Eight Unstructured interviews were held in the research environment, the dorm, with other tenants when they discarded or disposed furniture in front of the dorm or when they reused furniture. This was done to understand people's motivations and reasoning for these practices complementary to the observations (Zhang et al. 2009). In fact, these were mostly verbal, spontaneous, informal conversations (Zhang et al. 2009) without exposing the authors identity as a researcher.

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3.4 Structured Interviews

Structured interviews were requested with several people during the research in the form of emails and predefined questions (Zhang et al. 2009), mostly as a consequence of the constraints explained in the disclaimer and therefore avoiding meetings in situ. Only one structured interview was held completely (App.6) but was limited useful, as some questions seem to be misunderstood or were given answers that are in contrast to previous research findings. This reveals the weakness of this method, as it doesn't allow spontaneous responses between interview-partners to clarify the meaning of questions and the research context, respectively this is expected to be very time-consuming. Other requests for email-interviews were answered fragmentary, were rejected or not responded to at all. (App. 1 & 3)

Therefore email interviews are an extremely unsuitable format, due to the little information it gained in this research, and are based on a high motivation by the interviewee to participate due to the time-consuming aspect of writing answers, often not in his or her native language.

3.5 Auto-Ethnography

This research was auto-ethnographic as the research and living environment were the same for the author. Therefore he became a member or participant observer of the culture and its practices. To differentiate from a subjective story, methodological tools and research literature are used to analyze the experience (Ellis et al. 2011). Only this auto-ethnographic perspective enabled to observe, document and understand the problem in that intensity.

3.6 Observations

Observations were made to understand the behavior of the community at hand and their interplay with each other (Mack et al. 2005), centered around the research subject: furniture and how it becomes waste. This includes primarily the employees of DIK (the inspectors) and people living at DIK (the tenants) and other people less present. These focused and selective observations (Flick 2009) helped to understand the different discarding and disposal practices of the tenants and how the inspectors handle this furniture.

Furthermore, observations were made on the dormitory facilities itself and how the given infrastructure or physical context (Mack et al. 2005) influences these practices.

Lastly, it was noted when unusual amounts of furniture were discarded or when a the discarded furniture was moved or removed, these indirect observations indicated behavior of people, that was confirmed with other methods. Observational notes were recorded digitally, based on memory protocol (Mack et al. 2005).

3.7 Photographic Documentation

Photography was mainly used as evidence documentation (Spring 2001) for furniture discarded and disposed at DIK. As these pieces of furniture were continuously removed by the inspectors within a few hours and other people, it was necessary to capture these transient evidences before the scene was altered (Spring 2001). They represent a partial

account of data and must be read in conjunction with other data sources (Hinthorne 2014) like the observational notes.

The documentation of furniture-waste was done on a daily basis, four times a day, over the course of three months, February until April 2020, by searching for discarded products in front of the dorm blocks and at the waste-bins. Furniture discarded inside dorm-blocks was only documented twice for all blocks, as this was considered a disturbance of the tenant's privacy. The documentation is summarized in charts (App.9), instead of presenting all photos, which describe the type of product, it's condition according to the CE value cycles, where it was discarded and if it has been reused or disposed.

3.8 Analysis of Online Sources as Data

Publicly available web-pages were also a relevant source of information respectively became a databank.

Specifically the homepage of the responsible student housing organization (SHO) (KKIK 2020) was analyzed to show how many student accommodations they are renting, where they are located and how they are equipped. Based on these housing descriptions, a statistical chart was created (App. 2) that summarizes the amount of rooms and gives the percentage of furniture included. This was done to show the magnitude of unfurnished dorm rooms in the Copenhagen area.

Furthermore, the Facebook (FB) group of the dorm, *DIK Albertslund* (Facebook 2020), was analyzed in their functionality as an online platform to trade furniture locally, which also revealed other functions. Based on the given information, which were collected as screenshots, as some posts were later deleted, over a course of one year, statistical charts were created (App.12) and quotes collected.

3.9 Online Survey

An online or web survey (Bryman 2012) was conducted targeting current and previous tenants of DIK, for which it was send to the local Facebook (2020) group and to people of the social network of the author who had previously lived there. The survey was created using the online survey tool Google Docs (2020) (App.7) and the link was send twice, which was accessible from 18.-31.03.2020, resulting in 36 survey participants (App.8). The group has ca. 1500 members, whereas the dorm has max. 512 tenants, resulting in a response rate from ~2.4-7%. In total 41 questions were posed, including 35 multiple choice and two open questions (Bryman 2012).

The questions were formulated based on the analysis of the FB group, observations and desk research, therefore used to confirm or dispute these findings. Contextually they were asking for consumption and disposal practices of furniture and how experienced and open people are to consume 'sustainable' furniture.

The low response rate is typical for online surveys (Bryman 2012) and can be explained with the length, as it took ca. 8 min. to fill out, and the functionality of the FB page, as every new incoming message is pushing down the previous one, thereby reducing the likeliness to be seen. It was send during the start of the Corona shutdown (see disclaimer), which could have negative and positive influences on the level of participation. Even though the answers seem valuable, the representation of the dorm population is limited, which needs to be considered in the analysis.

The survey was revisited after test-run and feedback from a friend.

4.Literature Review

4.1 Environmental Impact of Furniture

4.1.1 Lifetime of Furniture

The average lifetime of furniture at the current state is rarely defined by scientific articles and when they are mentioned, the sources often can't be found.
Like the Ellen MacArthur Foundation (EMAF 2015), who mentions 8-9 years of average lifetime, referring to Eurostat, which is not traceably or Besch (2005), mentioning 12 years for office furniture without a reference. Other numbers stated are 7-10 years for various types of furniture (Montalvo et al. 2016) or for desks 15 years and chairs 5-10 years (Parker et al. 2015).

On the other hand, furniture companies like Vitsœ intends their furniture to last for a lifetime or longer (Bocken et al. 2016) and Emeco's aluminum Navy chair has an estimated lifetime of 150 years (Emeco 2019). But it is stated that the lifetime of furniture was longer in previous times (Renda et al. 2014). Therefore the current lifetime potential is not fully exhausted and could be immensely extended by furniture producers, so it is rendered short through different obsolescence mechanisms.

Figure 4.1: Emeco 1006 Navy chair (Emeco 2019, 5)

The significance of extending the product lifetime was demonstrated by Ingham (2011), who compared the relative impact for a chair with four differently long life-cycles, by conducting Life Cycle Assessments (LCA), that concluded: the product being longest in use has the least impact per year (see figure 4.2).
Hence product life extension strategies for furniture should be preferred.
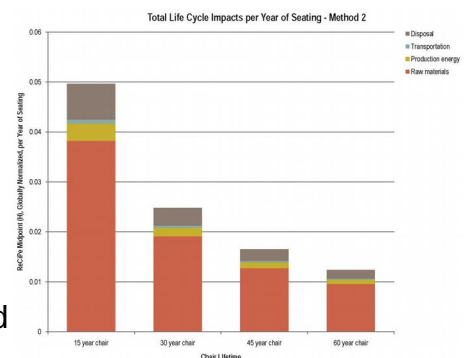
Figure 4.2: Total Life Cycle Impacts per Year of Seating (Ingham 2011,63)

4.1.2 Life Cycle Assessments of Furniture

One way to determine the environmental impact of products during their lifecycle is to conduct a LCA (Plaschke et al. 2019), for example presenting the Greenhouse gas emissions of the product in CO_2 equivalents (FIRA 2011). This is shown for the different life-phases, therefore allows to compare them as a basis for improving the product design, e.g. the choice of materials.

Several authors conducted LCAs for different types of furniture, but are majorly agreeing in the impacts during the life-phases, as summarized in table 4.1.

> Product / > Author / > Env. Impact Unit	Materials/ Preproduction	Production	Distribution/ Transport	Use	End of Life
> Wood furniture/ > (Vicente et al. 2009)/ > *Impact*	*up to 30%.*	*around 50,00%*	*same weigh as in the majority of industries*	*Close to zero*	Not mentioned
> various Wood Furniture/ > (JRC 2013)/ > Global Warming Potential	*Average 74%*	*Average 30%*	*Average 10%*	*0,00%*	*Average 1%*
> Office Desk/ > (Penty 2020)/ > C02kg equiv.	~ 61%	~31%	~6%	~0%	~2%
> office furniture/ > (Plaschke et al. 2019)/ > Midpoint	*100,00%*	*34,00%*	*14,00%*	*1,00%*	Not included
> Two Chairs/ > (Arvidsson et al. 2017)/ > climate impact	*69,00%*	*15,00%*	*5,00%*	*0,00%*	*11,00%*
	85,00%	*2,00%*	*2,00%*	*0,00%*	*10,00%*
> Shell Chair > (Ingham 2011) > Life Cycle Impacts per Year Midpoint H	~77%	~10%	~2%	*excluded*	~15%

Table 4.1: Overview of Environmental Impact for Life Phases (LCA) of Furniture based on literature review (created by author)

This shows that the highest impact is associated with the extraction and handling of raw-materials, followed by the manufacturing phase, in accordance with the visualization of an LCA for an office desk (see figure 4.3) (Penty 2020) (JRC 2013) (Parker et al. 2015).
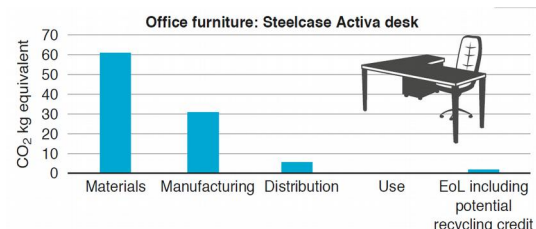
Figure 4.3: LCA Office Furniture - Steelcase Activa desk (Penty 2020, 40)

The use phase is specifically low for most pieces of furniture, as they don't consume energy during use and their maintenance through cleaning etc. was neglected (Vicente et al. 2009) (Ingham 2011). The end-of-life impact is low, but varies, as the authors use different treatments, such as recycling (Penty 2020), landfilling (Ingham 2011) and incineration (JRC 2013).

To reduce the impact of furniture in the material and production phase, some authors suggest to optimize this life phase by choosing less impactfull resources and reduce their amount (FIRA 2011).
But more importantly, the energy and emissions embedded in the resources of the product should be fully exhausted by making use of the product for a long time, extending the product life-time (Penty 2020) and thereby reducing the relative impact, per year, over the longer use phase. Due to their low demand in energy during use, there is little need to replace them with more efficient products (Ingham 2011).

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4.1.3 Waste in the Furniture Sector

By reviewing several international and national waste-reports, industry reports and statistics, reliable numbers on furniture-waste could hardly be found, as confirmed by literature (EEA 2018), that this waste-stream isn't measured separately in statistics in the EU or Denmark.
Central numbers are mentioned by several reports on the amount of waste and its treatment (Forrest et al. 2017) (JRC 2013), which cite a report by UEA, that isn't publicly available. According to these sources, furniture-waste makes up 3.75%-4% of municipal waste-streams, which is 10.78 Mil. t. in absolute numbers for the EU28 (Forrest et al. 2017) or ca. 21kg per capita and year, which is contrast to 15 kg mentioned (EEA 2018).

Considering the given number on ~10.5 mil. t. of furniture per year (Forrest et al. 2017), consumption and disposal are almost similar implying there is 100% throughput of furniture through society.

It is clear that furniture-waste is included in the bulky-waste stream (CoC 2020a) (EEA 2018), for which statistics are not available, except from one recent study (Larsen et al. 2012). Bulky-waste itself is included in the household- (EPA 1999) or residential waste-stream, with a share of 26% (Larsen et al. 2012). Even though bulky waste in Denmark makes up ca. 145-240 kg per year and citizen (Larsen et al. 2012), the exact share of furniture is not clear, but 30-40% can be wooden furniture (CoC 2014).

Based on Waste-Stream [Reference]	Calculation [References]	Total Amount of Furniture Waste kg/capita
Furniture-waste [6]	-	15 kg/capita (EU)
Furniture-waste [7]	10.78 million tonnes [7] / 513.5 million inhabitants [8] = 20.99 kg/capita	~ 21 kg/capita (EU)
Municipal Waste [1]	Municipal Waste 410.1 kg/cap [1] X 3.75% [7] = 15.38 kg/capita	~ 15.4 kg/capita (DK)
Household Waste [2]	447kg/cap [2] X 3.75% [7] = 16.76 kg/capita	~ 16.8 kg/capita (DK)
Municipal Waste [3]	747 kg/cap [3] x 3.75% [7] = 28.01 kg/capita	~ 28 kg/capita (DK)
Municipal Waste [4]	766 kg/cap [4] x 3.75% [7] = 28.73 kg/capita	~ 28.7 kg/capita (DK)
Bulky Waste [9]	145-240 kg/cap [9] x 30-40% [10] = 43.5-96.0 kg/capita	~ 43.5-96.0 kg/capita (DK)
Bulky Waste [calc. based on chart XX]	102.9 kg/cap [1] - 192.3 kg/cap [4] x 30-40% [10] = 30.87 – 76.92 kg/capita	~ 30.9-76.9 kg/capita (DK)
References: [6] (EEA 2018); [7] (Forrest et al. 2017); [3] https://ec.europa.eu/eurostat/statisticsexplained/index.php/Population_and_population_change_statistics [1] (CRI et al. 2016); [2] (DG 2013); [3] (DG 2015); [4] (Eurostat 2019); [9] (Larsen et al. 2012); [10] (CoC 2014)		

Table 4.2: Total Annual Furniture Waste in kg/capita in Denmark & EU based on literature review (created by author)

Based on the strongly varying numbers on municipal waste, for which Denmark holds the highest amount per capita and year in Europe (Eurostat 2019), and the given share of 3.75% furniture waste (Forrest et al. 2017), the amount of furniture-waste per capita and

year ranges between ~15.4 kg and ~28.7 kg (see table 4.2).
Based on the given (Larsen et al. 2012) and calculated numbers on bulky-waste, both referring to Danish sources, the amount of furniture waste in Denmark per capita and year lies between ~ 31 kg and ~96 kg (see table 4.2).

Furniture is collected in Europe from private, professional and institutional sectors through bulky-waste schemes (EEA 2018). In Denmark bulky-waste is collected through recycling centers (90%) and kerbside collection (10%) (Larsen et al. 2012). Whereas Fuentes (2017) analyzed, that in Greater Copenhagen, furniture is collected through recycling centers and the *storskrald* (bulk waste) room, which are spaces where neighbors from one or more buildings can leave different types of waste, such as furniture.
Larsen et al. (2012) explained that furniture can also be included in household-waste streams, due to the way they are collected and the size of the items, therefore the measuring in the bulky-waste stream is incomplete.

Bulky-waste collected at recycling centers can go into 20 (Larsen et al. 2012) or 32 different fractions, which requires instructions from staff for the correct disposal (Fuentes 2017).

A US-study by Fortuna et al. (2017) analyzed the consumption and disposal practices for different product types, amongst them furniture. Here they concluded that the most common discarding method was disposal as waste, followed by donation to a thrift store and other methods broken down in table 4.3.

Disposal methods	Total Amount Disposal (%)
Discarded as waste	106 (26.7%)
Discarded the item in a collection bin for second-hand products.	16 (4.0%)
Donated to a thrift shop or other similar organization	81 (20.4%)
Recycled via curbside recycling or sold/donated it to a recycler	16 (4.0%)
Returned to municipality during a special collection	3 (0.8%)
Sold on yard sale or swap event	34 (8.6%)
Sold or donated via a material exchange	11 (2.8%)
Sold or donated via online classifieds.	60 (15.1%)
Sold or donated via word of mouth	70 (17.6%)
	397 (100.0%)

Table 4.3: Disposal methods for Furniture (based on Table 6 Fortuna et al. 2017, 2461) (created by author)

Discarding methods should be convenient, require low effort and ideally operate locally. The placement of collection bins by reuse organizations in residential buildings and public areas can increase the recovery of reusable products as furniture (Fortuna et al. 2017).

On the European level, the treatment of furniture-waste is said to be 80-90% incineration or landfilling, and the remaining 10% to be recycled (Forrest et al. 2017), again referring to UEA's not publicly available report. Larsen et al. (2012) analyzed the treatment for bulky-

waste in Denmark to be 50-60% recycling, 30-40% incineration and 10% going to landfill. Whereas the bulky-waste in Copenhagen is mostly incinerated to generate electricity and heat (CoC 2020a). Fuentes (2017) analyzed that recycling stations can lead to reuse and reprocessing of materials into a secondary raw-material, whereas furniture at the *storskrald* is brought to incineration plants, where it is crushed or shredded into pieces, downcycled, incinerated and only metal is recycled. The different treatment methods are summarized in table 4.4.

Types of Waste [Reference]	Recycling	Incineration	Landfilling	(Compos ting)	(Other)
Municipal Waste (EU 28 – 2018) [4]	~ 29.9%	~ 27.9%	~ 22.7%	~ 17.1%	~2.4%
Households Waste (Denmark) [2]	36,00%	56,00%	4,00%		
Bulky Waste (Denmark) [9]	50–60%	30–40%	10,00%		
Furniture Waste (EU) [7][11-13]	10,00%	80-90%			
Furniture Waste [10]	Metal; "secondary raw-material"	Everything (except metal)	-		
References: [2] (DG 2013) [4] (Eurostat 2019) [9] (Larsen et al. 2012); [7] (Forrest et al. 2017); [10] (Fuentes 2017) [11] (FURN 360); [12] (JRC 2013); [13] (Parker et al. 2015)					

Table 4.4: Overview Chart - Waste & Furniture Waste Treatment in Denmark & EU based on literature review (created by author)

Additionally the nature of furniture as mixed materials that are not easy to separate doesn't allow to recycle the materials into something of similar value (Fuentes 2017), e.g. when different materials are connected through glueing or welding (Bärsch et al. 2001).

Considering the average composition of domestic and office furniture, they only consist of 12% and 28% metal respectively (JRC 2013), hence a resource loss of ~70-90% can be noticed with the current end-of-life treatment.

Furthermore it was explained that Copenhagen and other Danish municipalities invested substantially in large incineration plants, making this technology well established (CRI et al. 2016). Consequently the existent waste infrastructure created a lock-in (Zapata et al. 2014), where the most established technology is applied instead of the one that retains the most value.

The measuring of the furniture waste-stream and it's treatment need to improve strongly, especially since the bulky-waste-stream increases (by 30% from 1995-2005 in Denmark) (Larsen et al. 2012). Because furniture-waste remains hidden in statistics, its significance can't be clearly stated and the problem can't be perceived by the public.

Since the current waste-management mostly leads to huge value loss, getting furniture into this system should be avoided by all means necessary and any other option higher in the waste-hierarchy, such as reuse or repair, should be preferred.

4.2 Reuse of Furniture

When researching the reuse sector for furniture coherent and reliable numbers on the size of this sub-sector for the EU were not found in the reviewed articles, since no clear statistics are available (EEA 2018).

The turnover of the reuse sector for furniture is not clear, but for the EU-27 commercial second-hand goods, without charity, is ca. 8.1 bil. €. (EEA 2018) whereas in the United Kingdom (UK) the reuse sector for furniture makes up ca 101 mil. €. (Cools et al. 2016).

Part of the reuse sector is organized in networks, like RREUSE, which mostly consists of European members. They engage ca. 95 000 people and collected 200 000 t. of furniture of which 80 000 t. (40%) were brought into reuse in 2018 (RREUSE 2019). Whereas the Furniture Reuse Network (FRN) in England engages ca. 14 000 people, that have a throughput of 20 000 t of household furniture in 2006, of which 85% were brought into reuse (Curran et al. 2010). Other sources state only a 15% reuse rate for various furniture in England (JRC 2013).
Reuse for furniture is occurring in auctions, second-hand and charity shops, flea markets, is exchanged through online platforms as Ebay or Freecycle, social enterprises or reuse networks (Parker et al. 2015).

Furniture reuse is labour intensive and the refurbished goods have low economic value, which requires low costs, therefore charity or social enterprise rely on governmental subsidies or voluntary work (Curran et al. 2010), for example the FRN employs only 4700 people compared to 49000 volunteers (more than 90%) (Cools et al. 2016). But employment in this sector also follows a social agenda, as to integrate long-term unemployed people and people with disabilities in the labor market (EEA 2018).

The source of items is mainly through public donations (86%), or commercial organisations (9%) and waste-managers (5%) (Curran et al. 2010). The central goal of these organizations is to provide people in need with furniture (EEA 2018), which are the main beneficiaries (76%), but it is also sold to the general public (24%). Reducing waste through reuse is only of tertiary importance after the social goals (Curran et al. 2010).

Reuse at Recycling Centers

Furniture, brought to household waste recycling centers (HWRC) can lead to reuse as well, e.g. in the UK in total 83% and 40% of disposed bulky-waste can be considered reusable (Clarke et al. 2012). Whereas Larsen et al. (2012) in Denmark found only 9% of the large and 5% of the small combustible waste is reusable.
Hence furniture is often disposed before reaching the end of its functional life, so the reuse potential is not fully exploited. It is suggested that reuse measures should be part of the waste-management system (Larsen et al. 2012), e.g in the UK reuse-organizations collected bulky waste and achieved a reuse rate of 40%, compared to 3% when the job was done by collection departments (Curran et al. 2010).

Reuse in Copenhagen Area

Fuentes (2017) identified six initiatives for furniture reuse in Greater Copenhagen, like the online platform Den Bla Avis (DBA) which enables individuals to connect for selling and

buying used furniture. Whereas the *Byttecentre* is a space on a HWRC, where furniture can be donated to and reused free of charge, a service which requires sufficient, weather protective storage space and enough staff to handle the furniture (Fuentes 2017).

Environmental Benefits of Reuse

Environmental benefits, like reduced waste generation and saving of natural resources (EEA 2018) can occur when reuse offsets the need to produce new furniture (Forrest et al. 2017). Fisher et al. (2011a, 2011b) analyzed that one of the best resource efficiency strategies is reuse in terms of saving greenhouse gases, especially for sofas and office chairs (see table 4.5).

Furniture (1 tonne)	Direct Reuse (e.g. second-hand shop or eBay)	preparation for reuse network
Sofa [a]	1.45 tonnes (ca 55kg CO_2 eq per sofa)	1.05 tonnes (40kg CO_2 eq per sofa)
Dining Tables [a]	0.38 tonnes (ca 10kg CO_2-eq per table)	0.76 tonnes (ca 20kg CO_2-eq per table)
Office Desks [b]	0.4 tonnes	0.2 tonnes
Office Chairs [b]	3 tonnes (ca 35kg CO_2-eq per chair)	2.6 tonnes (ca 30kg CO_2 -eq per chair)
[a] (Fisher et al. 2011a); [b] (Fisher et al. 2011b)		

Table 4.5: Benefits of Reuse for different types of Furniture: Greenhouse Gas savings per tonnes of furniture in tonnes CO_2- eq. net. compared to landfill (Fisher et al. 2011a, 2011b) (created by author)

Challenges for Reuse

Upholstered furniture that doesn't have a fire-safety label attached cannot be brought into reuse by commercial or charity second-hand due to legal concerns (Penty 2020). Other items are difficult to be reused due to hygienic concerns such as mattresses (Forrest et al. 2017). Furthermore, many waste-management systems don't have effective approaches to bring furniture into reuse and legislation is lagging behind (EEA 2018).

The bulky and heavy nature of furniture requires space for storage and transport, hence challenges reuse for second-hand shops, charities and measures as the *Byttecentre*. On the other hand, furniture that can be dis- and re-assembled, as those from IKEA, is made of low quality materials, that reduce the likeliness to sell it (Fuentes 2017). Furthermore reuse depends on the condition of the item, the collection method and the aesthetics (Alexander et al. 2009).

Furniture reuse also holds economic potential, as implementing reuse measures can create 156 000 (Forrest et al. 2017) to 300,000 new jobs (FPRCR 2015) in the EU.

4.3 Repair & Remanufacturing of Furniture

The repair sector for furniture is hard to quantify, as data are only available for repair of computers and personal and household goods, (EEA 2018) without a breakdown for furniture. Based on the given statistic Denmark seems to have less than 2000 enterprises in that specific sector in 2015, which could be further encouraged through tax regulations (EEA 2018, 29).
On the one hand the number of repair-cafés increases (EEA 2018), on the other hand the

number of repair shops in Denmark decreases, as the low price and bad quality products create a no-need for repair (Fuentes 2017).

The market for remanufacturing of furniture is ca. 310 mil.€, representing only 0.4% of the industry and employing only ca. 3400 people (Parker et al. 2015), compared to the several ten thousands employees in reuse networks. Remanufacturing mostly occurs in the office furniture sector (Parker et al. 2015).

The environmental potential of remanufacturing is given, as ca. 80% of a remanufactured good is usually retained from the core product. In total, remanufacturing for all industries in Europe present savings of CO_2 emissions that is equivalent to those generated by all Belgium cars (Parker et al. 2015).

Challenges for remanufacturing are plentiful such as organizing logistics for returning the products to the manufacturers, providing storage capacities for stock supply, competition through low-cost furniture, a limited market due lack of consumer confidence in the quality, as well as legislative restrictions (Parker et al. 2015).

4.4 Legislative & Political Instruments

The EU and the EC developed a few political instruments and programs to make products more environmentally sound, such as the Green Public Procurement (GPP), the EU Ecolabel, the landfill and waste directive and an Extended Producer Responsibility (EPR) strategy (Donatello et al. 2017). But it should be kept in mind that not all of them encompass furniture, like the Circular Economy Action Plan of 2020 (EC 2020) or eco-design requirements are covering only energy-related products (FPRCR 2015) and that GPP and EPR are yet only voluntary.

Extended Producer Responsibility (EPR)

An EPR is a policy principle or strategy for environmental protection, for which the manufacturer of a product is held responsible for the entire life-cycle. It does not represent a legal tool, which instead must be implemented by national or international administrative, economic and informative instruments (Lindhqvist, 1992 in FPRCR 2015).
Even though these EPR schemes were established more than 20 years ago in the EU, they have so far focused mainly on approaches handling the end-of-life of products once they became waste (FPRCR 2015).
The goal of an EPR in regard of CE is to create upstream and downstream effects. Such as introducing a fee which reflects the real costs of an end-of-life treatment of products, and put these costs from the public budget, as it's currently the case, on to the producers (FPRCR 2015). Upstream effects are thought to promote design changes for products, so they become more suitable for reuse, recycling and reduce its hazardous content (FPRCR 2015).

Existing EPR schemes

An EPR scheme for furniture does not exist on the EU level, but is implemented in France for the collection, recycling and reuse of domestic and commercial furniture waste-streams (Forrest et al. 2017).

It sets objectives to achieve, like decreasing furniture send to landfill or a 45% reuse and recycling rate, as well as defining design criteria (Eco Modulation Criteria) for the development of new furniture , such as the amount of materials in new metal or wooden furniture to easen recycling (Forrest et al. 2017).

The scheme requires manufacturers and retailers operating in France to register, which then adds a fee for recycling on the product's price (Guldmann 2018) and if companies comply with these criteria they pay a reduced

Figure 4.4: Existing EPR schemes and products covered (FPRCR 2015, 11)

fee on the product (Forrest et al. 2017). It seems quite successful as in 2015 0.85 Mt of domestics furniture were collected, achieving a 55% recycling and 85% recovery rate (Forrest et al. 2017).
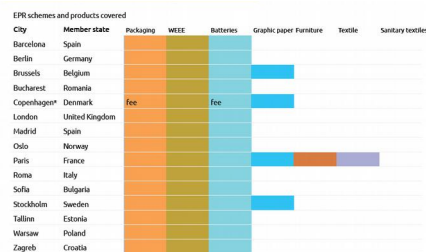
Administrative Instruments

One typical instrument in EPR schemes is the take-back of products by producers from the customers at the end-of-life. This could go in hand with setting targets for reuse, recycling, recovery and separate collection of waste-streams (FPRCR 2015).

A restriction of substances that can cause harm to the environment and people during its life-cycle is recommended as well (FPRCR 2015). Like flame retardants as used in upholstery of furniture, which can reduce the durability, products containing them cannot be recycled and can put harm to humans when combusted or in case of fire as they generate toxic fumes (EFIC 2).

Other specific instruments could be the implementation of a ban on incineration to increase recycling rates for furniture (FPRCR 2015). The right for repair, as in place in the US-American automotive industry could be adopted in Europe for furniture, specifically designing products to be repairable, providing spares or a longer mandatory warranty (Forrest et al. 2017).

Economic Instruments

The implementation of economic instruments were considered particularly effective to meet recycling and recovery targets for schemes of other product categories (FPRCR 2015).

Since the increasing demand for low-price furniture has lowered the entry barriers for foreign goods, the domestic market is exposed to price competition caused by low labour (Parker et al. 2015) (Renda et al. 2014). Therefore economic measures should not only cover local producers and retailers, but also importers (Forrest et al. 2017).

A broad measure could be the implementation of an environmental tax reform, that should shift the tax burden from labor to production (FPRCR 2015), as also promoted by Stahel & Clift (2016) since they consider labor a renewable resource. Currently taxes for labour make up 53.3% compared to 5.7% of environmental taxation (FPRCR 2015).

For example Sweden introduced tax breaks for repair of household-items and furniture to stimulate the local repair industry (Forrest et al. 2017), an approach which the Danish government has not yet followed (Fuentes 2017). Even though EU member states have the freedom to define VAT on services and good on their own (Forrest et al. 2017).

These taxation measures could also include reuse and remanufacture, charging lower taxes for durable products and higher taxes for those that are resource intensive, have a short lifetime or are non-recyclable, specifically a taxation system designed in accordance with the waste-hierarchy is suggested (FPRCR 2015). Like output taxes on landfill and incineration or input taxes on virgin raw-materials for production (FPRCR 2015).

Other economic incentives could be direct financial support, like the Circular Economy Investment Fund in Scotland (Forrest et al. 2017).

But these measures should consider that the furniture sector consists largely of SMEs, therefore future instruments should be adapted to the size of the company (FURN 360, 2018) as well as their position in the waste-hierarchy (FPRCR 2015).

Informative Instruments

Informative instruments should be used to report information on the products to authorities and be accessible for consumers and businesses, such as the amount on the market, how they are treated, reused, disposed etc. through these EPR programs (FPRCR 2015). Mandatory requirements for reporting furniture-waste are yet missing, therefore it doesn't appear in statistics.

In the EU, there are 11 national and 8 EU-wide measures in force promoting quality furniture to consumers. Only five of these are mandatory schemes, all on national level such as two flammability labels for upholstered furniture in the UK and Ireland (Renda et al. 2014). Those labels are relevant, as upholstered furniture for sofas or mattresses without this label, e.g. since consumers removed the label (Forrest et al. 2017), cannot be resold through commercial second-hand schemes, which can result in an increase of furniture-waste (Penty 2020).
Since all 8 eco-labellings are voluntary schemes, the uptake is limited (Renda et al. 2014), which is exemplified, as in 2020, the EU Eco-Label for furniture lists only 45 products in total (EC 2017).

The most encompassing approach is the suggested 'Green Furniture Mark' (GFM), which would be a mandatory labeling based on a variety of CE criteria, measured on a certain scale (Forrest et al. 2017), which could also be the foundation to model the taxation system with.

Green Public Procurement (GPP)
GPP is a voluntary political instrument that gives public authorities criteria how to handle purchases for products, including furniture, for institutions and public spaces in an environmental sound way (EC 2019b). The uptake of it is limited due to it voluntary nature (Forrest et al. 2017).

4.5 Obsolescence of Furniture

Furniture is also discarded due to aesthetic obsolescence (Fuentes 2017), either when consumer furniture become fashionable, it is updated and replaced more frequently (Penty 2020), or when the furniture's surfaces look used up (Hebrok 2016).

Furthermore the relative affordability and cheapness of mass-produced, flat-pack furniture render furniture economically obsolete. The central problem is that repair and other life extension services have become more expensive compared to the purchase of new furniture, which is also supported by the design making it hard to repair (Penty 2020). Economic growth of a society is explained to contribute that more furniture is discarded at HWRC (Fuentes 2017).

Another central problem mentioned is *material obsolescence*, as many materials, finishes and joining method make the product non-durable and hard to repair. Specifically flatpack design, as from IKEA is not made to be dis- and reassembled multiple times (Penty 2020). Renewing, maintenance and upgraded is challenged as the construction and methods are making it hard to comprehend and repair them (Hebrok 2014). Bad production design, reasoned within the business model, results in the use of poor quality wood, that breaks easily and joints that wear out quickly, as from IKEA, whereas furniture from previous decades is more robust (Fuentes 2017).

Changes in life are mentioned as reasons for discarding furniture, like in the social structure of the household (Hebrok 2016) and that people are moving more often nowadays (Penty 2020). On the one hand people want to purchase new items when they move, on the other hand moving or discarding furniture requires a vehicle (Fuentes 2017). Coupled with the bulky nature of furniture, it is not transported, making it logistically obsolete.

4.6 Circular Furniture-Design

Scientific articles were reviewed to assess how to design furniture for the CE, but an overview of design-strategies, -criteria or -tools was barely found.
The most comprehensive overviews were presented by Penty (2020) and can be found in the office sector such as Dutch manufacturers Vepa (B.V. 2019) and Gispen (2015), who developed a framework to design their products circular (see figure 4.5).

Figure 4.5: Circular Economy Framework (Gispen 2015,22-23)

Materials:

The use of renewable resources should be preferred as they can grow faster than they are consumed and are associated with less energy consumption in their preparation (Rashdan & Ashour 2017). Low impact materials should be preferred over high impact materials, like wood over metal, such as

Figure 4.6: Cardboard Table (Penty 2020, 268)

furniture made from cardboard (see figure 4.6) (Penty 2020). Even though it is criticized for it's short lifetime, which can lead to a more frequent replacement (Vezzoli & Manzini 2008).

According to Penty (2020), recycled content, renewable or non-renewable, should be preferred over certified, renewable virgin sources, which can result in environmental benefits as less materials being incinerated or landfilled and less resources being

extracted (Rashdan & Ashour 2017). To ensure products and components are recyclable, different materials need to be separable by avoiding hybrid-materials (Penty 2020), which also requires a respective recycling infrastructure (Rossi et al. 2006).
For example Vepa (B.V. 2019) is producing felt mats by recycling post-consumer PET bottles collected in Dutch canals, as used in their chairs.

The use of local or regional resources can reduce environmental impact due to less transportation (Rashdan & Ashour 2017), which is contrast to the status quo of the industry following a global sourcing strategy (Renda et al. 2014). This becomes important for CBMs, considering take-back schemes, as non-regional operation results in higher CO_2-emissions, as calculated by Vepa B.V. (2019), see figure 4.7.
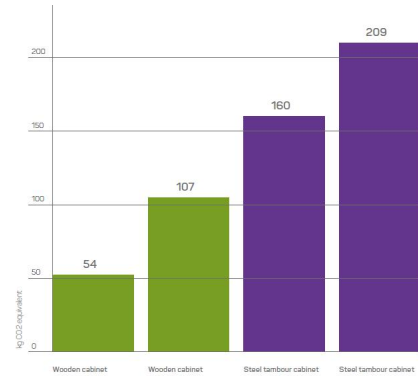
Figure 4.7: The CO_2 footprint in the production of cabinets (incl. transport) (Vepa B.V. 2019, 23)

The manufacture of certified materials can ensure that it is sourced and produced environmentally and socially sustainable, especially for virgin materials, e.g. through standards as FSC certified wood or Oeko-Tex for textiles (Vepa B.V. 2019) (Penty 2020).

Materials should be treated to exclude any hazardous or toxic chemicals, e.g. fire retardants or volatile organic compounds, that could affect the environment and health of people during manufacture, use or end-of-life treatments (Rashdan & Ashour 2017).

An efficient use of materials is a strategy in furniture design so it becomes lightweight, but still provide maximum strength, as Alvar Aalto's plywood chair (see figure 4.8). On the other hand, efficiency in production and resulting lowered product prices can increase the overall resource-consumption, described as rebound-effect (Penty 2020).

Figure 4.8: Alvar Aalto's plywood chair (Penty 2020)

Design for Durability – Physical, Emotional and Aesthetic

Physically durable design means that furniture has a high quality and needs low-maintenance due to it's construction, joinery techniques and choice of materials and consequently the product can be used for a long time (Rashdan & Ashour 2017) (FURN 360, 2018). Due to the long life-cycle, these products are expected to be replaced less frequently, but require higher costs upfront, therefore encourage sufficiency (Rashdan & Ashour 2017) (Bocken et al. 2016).

Timeless design is mentioned often by furniture designers, who claim to create an aesthetic that never goes out of fashion and thereby overcomes aesthetic obsolescence (FURN 360, 2018) (Vepa B.V. 2019). Vitsœ, which produces furniture continuously since the 1960's, like their *606 Universal Shelving System*, exemplifies this, see figure 4.9 (Bakker et al. 2019). This term can be coined *aesthetic durability* as the aesthetic fights fashion obsolescence and
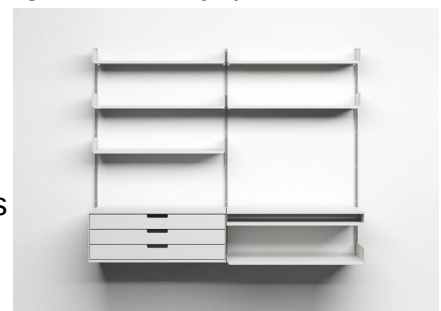
Figure 4.9: Vitsoe's 606 Universal Shelving System (Architonic 2020)

thereby implies to be accepted over generations and a broad user group.

Creating an emotional connection or relationship to products, as it holds memories and positive experiences, and is therefore not replaced unthoughtful, is the intention of *emotional durable design* (IKEA 2019). This can be supported through durable and adaptable design, therefore possibly owning furniture for a long time or through customization and DIY-practices (Salvia & Cooper 2016).

Design for Adaptation

Modular Design implies that components or parts are interchangeable and can be replaced when they are defective, instead of the whole product (Vepa B.V. 2019) (Bosch et al. 2017).
Universal modules that fit with other products allow to aesthetically and functionally update, adapt and upgrade products, to changing needs such as chairs, where backrests or upholstery can be exchanged (Gispen 2015). Modules can also enable to extend the product, e.g. shelving systems, which allows to adapt to different living environments and changing needs to store items (Penty 2020).

Figure 4.10: Modular seating system (Bosch et al. 2017,320)

Figure 4.11: Modular shelving system (Penty 2020, 267)

Customization can be enabled through modular design, so consumers can compile the product according to their needs from a variety of modules (Gispen 2015). Furthermore this can be achieved through materials, e.g use of unique materials in upcycled products (FURN 360, 2018) or through *Open Design*, where consumers can customize their product online (Penty 2020).

Design for Adaptation means that the furniture can adapt to the momentarily and future, long-term needs and living situations of the consumers by providing flexible solutions (Rashdan & Ashour 2017) (Bosch et al. 2017). This can be achieved by designing furniture so parts can be added, removed or changed, which requires anticipating possible life changes, e.g. a chair that grows with the user (Penty 2020).

Figure 4.12: Peter Osvik's Tripp Trapp Chair (Penty 2020, 254)

Multifunctionality can also enable adaptation, as a piece of furniture can be modified from one function to another, as it combines the function of several items (Rashdan & Ashour 2017). The main differentiation to be made here is between functional and aesthetic adaptability.
Design for disassembly allows to take furniture apart into interchangeable modules or components (Bosch et al. 2017). This enables life-time extension activities as maintenance, upgrade, refurbish and remanufacture and recycling, as mixed materials would have little value in recycling programs to achieve closed-loop material streams (Rossi et al. 2006) (IKEA 2019). Like a chair from Hermann Miller, which allows disassembly and recycling of 96% of the parts (Rossi et al. 2006).

Maintenance should be made easy to perform (IKEA 2019), therefore anticipating these tasks is crucial, such as cleaning of surfaces or upholstery (Penty 2020). The ability to keep a piece of furniture hygienic, e.g. mattresses, will influence its ability to bring it into reuse (Forrest et al. 2017).

Design for Standardization means through standardized fittings and modularity, exchange and repair of broken parts is enabled, which also reduces the number of needed spare parts (IKEA 2019). However spare parts should be provided to enable self-repair, that should be easy to perform, by the customers to avoid premature disposal of the whole product when only certain parts are malfunctioning (Salvia & Cooper 2016) (Penty 2020).

Figure 4.13: Mirra Chair disassemlbed into recyclable parts (Rossi et al. 2006, 199)

Design for space-saving transport and storage are criteria that reduce the volume and weight of furniture, countering it's usually bulky nature, and enabling more efficient and convenient logistical activities (Bosch et al. 2017) (Penty 2020). Even though flatpack design is widely used in the industry with the aim to rationalize transport due to non-local production, the resulting design is rarely made for multiple dis- and reassembly (Penty 2020). More efficient transport is crucial for CBMs, requiring reverse logistics and when people want to move with their furniture, which can be enabled through stackable, inflatable, disassemble and foldable design (Hennessey & Papanek 2008).

Figure 4.14: Flatpack table (Penty 2020, 276)

Design for Upcycling, when practiced by private people, is associated with the DIY field which holds the potential to create emotional attachment to these self-manufactured artifacts and prolong the lifespan of the materials (Salvia & Cooper 2016).

4.7 Circular Business-Models for Furniture

Circular Business Models for furniture can mainly be found in the office furniture sector (Penty 2020) and most research-examples were found in this sub-sector, too.

For a PSS, this can be either companies, which design furniture suitable for recycling (close the loop) or those who decrease the consumption of furniture, e.g. through extending the product's lifetime (slow the loop), as Besch (2005) researched in the office sector.

Organization of a PSS - Renting or Leasing

Renting or leasing presents a use-oriented PSS (Besch 2005).
The basic idea is that furniture is rented instead of sold by the customers from the manufacturer, who also provide services like maintenance, repairing and up-grading. At the end of the fixed renting period, the furniture is returned when the contract is finalized or replaced, as a whole or parts when the contract continues. Retailers link both parties if a

direct interaction is not possible (Besch 2005). The returned furniture can for instance be stored in remanufacturing or refurbishment centers as circular supply until it is reused (Vepa B.V. 2019).

To ensure economic feasibility of reverse logistics, it is necessary to design them cost-effective, which depends on the transport distance and the amount of furniture serviced by one provider. Due to the bulky and heavy nature of furniture, the transport should be done as little as possible from an economic and ecological perspective. Hence providers should operate as local as possible and service tasks should be done on site, so the furniture doesn't need to be moved (Besch 2005).

Product-oriented service packages for office furniture can provide additional revenue streams to balance out reduced sales volume due to the long-lasting, durable products. On the other hand these services have to compete with cheap, new office furniture (Besch 2005). This requires to convince customers on the long-term financial benefits of a PSS.

Specific examples are Dutch company Gispen, which offers take-back and maintenance services to update and reconfigure furniture to the changing needs in an office (Forrest et al. 2017), e.g. chairs that allow to exchange parts through modularity and thereby upgrade and update them functionally or aesthetically on site (Gispen 2015).

Challenges of a PSS

One of the central challenges are economic barriers, since the take up of a PSS is a financial risk (Besch 2005), e.g. because costs arise at the beginning of a leasing period, revenue flows will come late in the rental period (Bosch et al. 2017). This means the company needs to have a solid financial basis to cover these costs, being able to invest money in the design and production of circular furniture etc. (Besch 2005). Considering that the majority of the industry are SMEs (Forrest et al. 2017), it is clear that they don't have the financial resources (Besch 2005) or manpower to set up a PSS.

Other challenges are market conditions that competition is mainly based on prices and consumers low willingness to pay a higher price for an environmentally sound product or service. The absence of a mandatory EPR doesn't create legislative pressure for manufacturers to be responsible for the end-of-life costs arising. Manufacturers show little interest in environmental benefits only and are resistant towards the mental and organizational changes a PSS requires (Besch 2005).

Sector Coverage of PSS

Circular solutions are already implemented by Finnish furniture-producer Martela for businesses, schools and public spaces (Kiørboe et al. 2015). Also companies with short-term project work are listed as suitable customers for renting furniture, if it presents a cost-advantage (Besch 2005).

Figure 4.15: iFixit's Repair Manifesto (iFixit 2020)

Reuse & Repair

Besides conventional reuse options, the Swedish online platform *Off2Off*, enables reuse for organizations of the public or private sector,

which matches supply and demand of products like furniture. These organizations can inform each other on surplus products that want to be given away or are requested, enabling reuse within the platform's network (Kiørboe et al. 2015).

Innovative businesses for repair are repair cafés, repair events and open access websites offering repair guides, like the online platform iFixit (Penty 2020). Even though these instructions are for electronic devices, this concept could be adapted to furniture. Their Repair-manifesto (Penty 2020) is in line with the demanded right for repair (Forrest et al. 2017).

4.8 Users in the Circular Economy for Furniture

In the CE, business-models like leasing, renting or sharing, consumers become users of the products, which are returned to the manufacturer with their components and materials at the end of the use cycle. They can hold benefits for the users as higher level of customization and broader choice due to tailoring the service and products to the individual needs, and possibly reduced ownership costs as producer create durable and reusable products (EMAF 2013).

IKEA (2019) states that practical, financial and emotional benefits want to be seen by their customers, whereas sustainability of the products is of secondary importance. The major behavioral driver for acquiring, caring and passing on products is convenience (IKEA 2019).

A survey conducted by Renda et al. (2014, 144) in 2013 with 27 to 55 year old Europeans, asked the participants on the influential purchase factors for furniture, resulting in a clear hierarchy (from high to low priority): *product must fulfill taste and needs; price; environmental friendliness; a specific brand*.

Figure 4.16: Motivations for second-hand consumption (Edbring et al. 2016, 8)

Edbring et al. (2016) examined in their study consumer attitudes towards sustainable furniture: second-hand, renting and leasing, and sharing, identifying motivations and barriers for the uptake of the 20-35 years old, Swedish IKEA customers.

Accordingly, the main-drivers for second-hand consumption are *economic reasons* for almost half of the respondents, especially amongst students, followed by the *desire to be unique* and *express the personality* (25%) through the furniture, whereas *environmental reasons*, e.g. avoid hazardous substances, is the main-driver for only 14% (Edbring et al. 2016, 8).

Obstacles for the purchase of used furniture are concerns about hygiene, meaning not fresh, and pests, specifically infection by bugs for 8 out 9 participants. This is also reflected in the type of furniture, as everything with textiles and upholstery, like mattresses and sheets is mostly rejected (67%), in contrast to the openness to buy tables and chairs second-hand (Edbring et al. 2016).

The attitudes towards leasing and renting is mostly negative, respectively only for selected products, such as tables, chairs and shelves. People are more open to rent furniture for a

short-term (62%), such as events (Edbring et al. 2016).

The main-drivers for this type of consumption are flexibility and economic reasons, as it is associated with more freedom and lower costs to access a product when required for an event. The temporary leasing was seen more positive amongst 20-24 years old respondents (49%), when used under certain circumstances e.g. students who temporarily live abroad. Environmental and economic benefits seemed less evident to the participants (Edbring et al. 2016).

Motivations for access-based consumption

- Flexibility
- Economic reasons
- Temporary nature of use
- Environmental reasons
- Opportunity to test
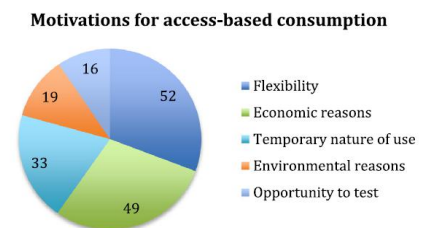
Figure 4.17: Motivations for access-based consumption (Edbring et al. 2016, 10)

The main challenges here are, that ownership is the preferred mode of consumption, as furniture should express ones personality, as well as hygienic concerns, due to not knowing how clean previous owner left the product. The unfamiliarity with the concept, as well as anxiety to break something and being penalized with furniture not being owned are mentioned concerns (Edbring et al. 2016).

To summarize, consumption is mainly driven by economical and less by environmental reasons and the uptake of the reviewed alternative modes is dependent on hygienic factors and a PSS scenario could be accepted under certain circumstances, e.g. for temporary usage.

4.9 Furniture-Waste in Dormitory Environments

Most of the reviewed articles show that furniture waste is a significant issue in dormitories of universities in the USA. Accordingly, an average American college student produces each year 640 pounds (ca. 290 kg) of solid waste (ChasingGreen 2011), most of it in May and June when the academic year is over (Planet Aid 2015). New and used products of various types are disposed: from furniture like beds and shelves, to household-items like fridges, to clothes, books, food and much more (Gordon 2007) (Sloan 2018).

The main reason why so much waste is generated, is that the dormitory tenants move out, so changes in life (Sloan 2018) (Planet Aid 2015). As some people move abroad, since they were international students they often don't take their items with them (De Spiegeleir 2019) (Gordon 2007). A rushed packing of the belongings and unplanned behavior of what happens to the objects at the move-out can result in wasted products, too (Sloan 2018). Technological obsolescence due to replacement of electronic products, as well as purchasing and disposing products that could be shared, like printers, were named as reasons for waste as well (De Spiegeleir 2019) (Gordon 2007). Besides, unthoughtful purchases by students and gifts received from relatives are contributing to the issue, too (Sloan 2018) (Gordon 2007).

Nonetheless, solutions trying to reduce the waste are pursued, such as donations to charity organizations (Sloan 2018). Even though this practice enables reuse, it also accepts that continuously more products are brought into the dormitory environments and subsequently they are brought into the second-hand system with unforeseeable downstream effects (Eppolito 2018). Instead, local solutions should be preferred, that keep products in use, cycling in the microcosm of dormitory environments, that could also

reduce transport impacts (Peak 2015). Selling through online-platforms as *ebay* or *Freecycle*, donation from peer to peer, or events like dorm yard sales and flea markets are commonly practiced (ChasingGreen 2011).

Whereas Dutch students opened up a student-lead swap-shop, for household-items left by international tenants, offering them for free to new arrivers (De Spiegeleir 2019). A similar concept for furniture was taken up by US-students, who collect disposed furniture after the study period, store it and sell it to new students (Peak 2015).

Only few articles address the root of the problem, that renting unfurnished rooms creates the demand to obtain furniture. A Danish dorm, the *Grønjordskollegiet* (2020), offers to borrow basic furniture through a furniture-bank (Møbelbanken).

A more complete approach is taken up by New York University (USA), which not only offers furnished rooms to their students, but cooperate with a firm that produces furniture from FSC-certified wood and guarantees a minimum product-life of 25 years, including life-extension services (Dix 2018).

5. Presentation and Analysis of Empirical Data

5.1 Student Housings in the Copenhagen Area

In the Copenhagen Area, three Student Housing Organizations (SHO) were identified. In total they have a capacity of ca. 45100 rooms (App. 2), of which the two biggest SHOs were not able to provide information if their rooms are furnished (App. 3), as visualized in figure 5.1.

Danmarks Internationale Kollegium (DIK), is rented out by the SHO Kollegiernes Kontor I København (KKIK), which is in total renting 8108 rooms in 30 dorms in the Copenhagen area (App. 2; KKIK 2020). Due to analyzing their database on student housings, it was found that ca. 62.7% and 0.4% of the offered rooms are specifically described as being rented without and with furniture, respectively.

Figure 5.1: Housing Organizations in Copenhagen Area - Amount of Rooms Furnished (App. 2, 3 - Graphic created by author)

For further 36.9% it is not specifically confirmed or denied that furniture is included, but as the descriptions for the apartments are otherwise very detailed about what they include, e.g. own bathroom and kitchen (DIK 2020), it can be assumed that these rooms are most likely unfurnished.
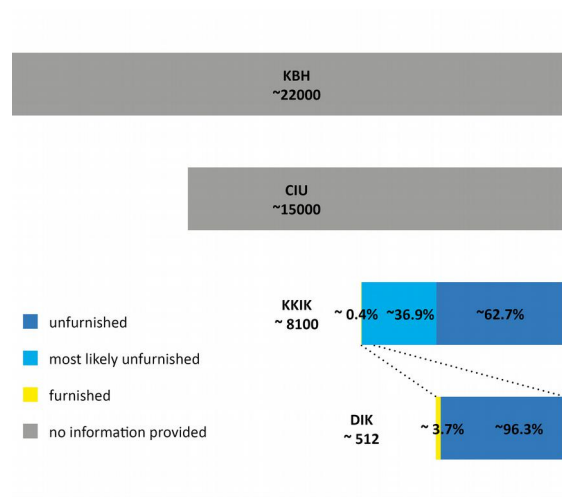
5.2 Case Study Danmarks Internationale Kollegium (DIK)

DIK is located in Albertslund municipality close to the Copenhagen Area in Denmark.

An analysis of the area and interviews confirmed that most places to buy or obtain furniture in stores, are not in walkable distance, as visualized in figure 5.2. The nearest by options are furniture retailer Jysk and the local HWRC Albertslund Genbrugsstation (AGS),

where people can
 pick-up used furniture or free, but for both a transportation vehicle is required. The local Red-Cross-Store doesn't offer furniture. In the neighboring village Taastrup, which can be reached, e.g. via train, the closest second-hand- and repair store for furniture can be found, as well as the furniture retail giant IKEA.
Hence sustainable consumption alternatives, like used furniture, are not easy to reach and are usually in the same distance as furniture retailers, and if they don't offer delivery services, like IKEA (App.10), have an inferior competitive position.
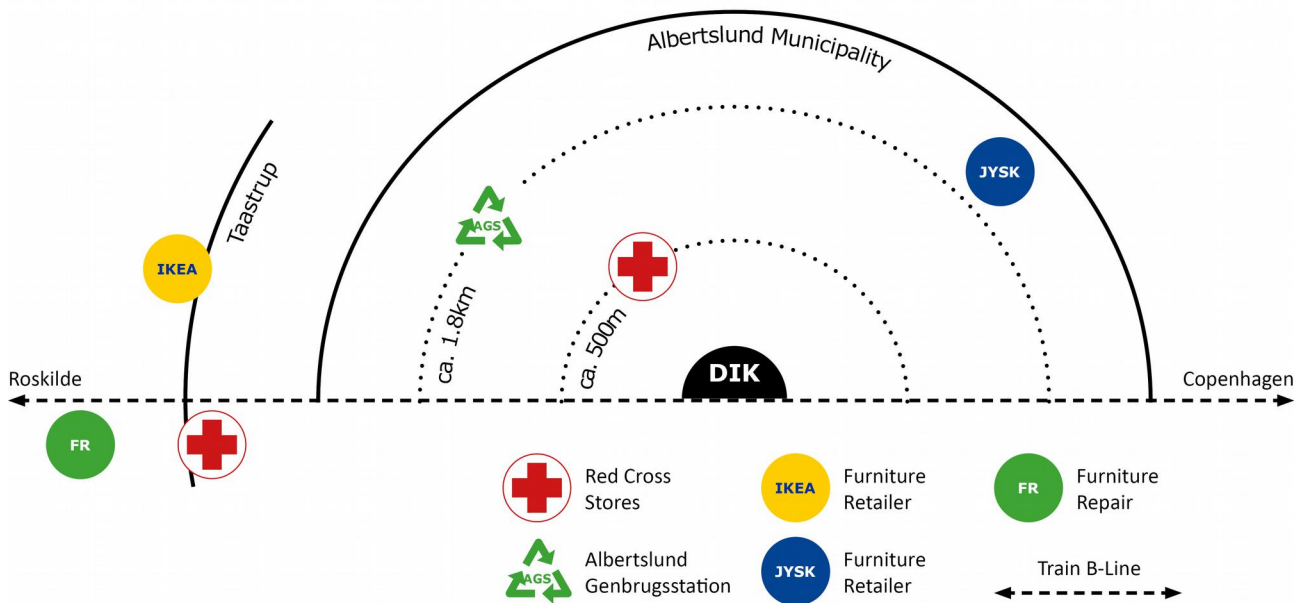
Figure 5.2: Places to obtain Furniture near DIK (graphic created by author)

DIK was built in 1972 and is divided into 16 concrete blocks, which provides space for 512 residents. The facilities in the rooms include a built-in wardrobe, a corridor ceiling lamp, a built-in bathroom shelve and mirror, shower curtain, shower hose, toilet seat, and a window blind (DIK 2020).
Otherwise all of the rooms are rented unfurnished (App.5 & 6), as visible in figure 5.3, therefore the tenant takes over and has to leave the room without furniture in it. He or she has to take care of obtaining and discarding furniture needed during the rental period. However, 19 out of the 448 rooms are sub-rented by Aalborg University Accommodation Office (AUAO) to international students, which includes furniture (App. 4).

Figure 5.3: DIK Dorm Blocks & A Room for one person at DIK - unfurnished (DIK 2020)

The inspector estimated that approximately 20 tenants are moving in and out each month, which would sum up to ca. 240 out of 512 tenants each year, and that the average residence time is half to one year (App.5).
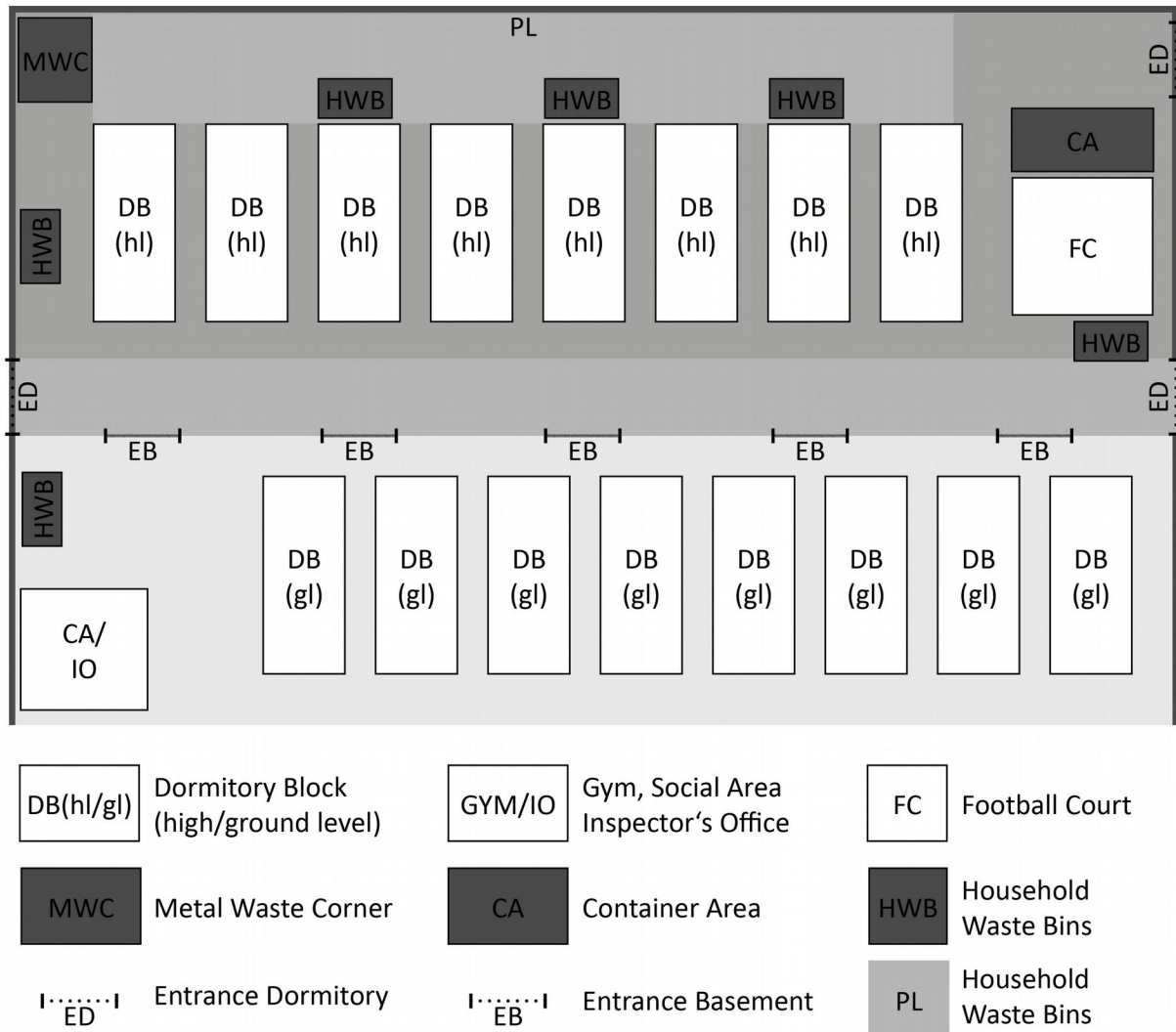
Figure 5.4: DIK - Ground-plan of whole dorm (Graphic created by author)

Figure 5.4 shows the ground plan of the whole dorm and gives orientation where each of the areas are located, which will be explained later in the text.

5.3 Different Practices of Inspectors of DIK

The staff working at DIK will be referred to as inspectors in this analysis, who have various maintenance tasks inside and outside the dorm blocks.

The Tenant's Rooms

One of them is to arrange the hand-over of the rooms when tenants move in and out of them, as they have to be empty at the move-out day (App.5).

For each new tenant moving in the room is painted and equipped with a new shower curtain and new window blinds. The inspector explained the practice for the blinds as

follows: *"I will tear it down and put it into the iron container. A new one cost 160 Danish Crones, it's very cheap, we buy them at JYSK."* (App.5). He states that 9 out of 10 blinds are disposed and shower curtains for every new tenant as it should look clean, since the blinds can easily look worn out or change color.

When asked if he could maintain, clean or repair them, he says that it is decided on a individual basis, but renewing them is the quickest and most cost-efficient way of handling it, as the costs for his labor for these practices would exceed the price of the new product, making them economically obsolete.

The disposal practices is additionally fueled by the design, which is not made for repair, so when a cord rips or a slat is bended, the whole product is disposed.

Alternatives are considered as well, but are neglected due to the expected arising costs for maintenance: *"We are also thinking to get some curtains [...] So you could take them down and wash them. But, again, there is someone who has to do the laundry."* (App. 5).

On the other hand, most of the blinds that were documented in the metal-waste bins were almost new and less than in a condition that fits the described criteria. Hence a the majority of the blinds are prematurely disposed, rather out of a habit than based on objective criteria.

Other items in the rooms like toilet-seats or shower-hoses are less frequently exchanged, but are also not repaired when malfunctioning and instead disposed.

Built-in Wardrobes and Bathroom Shelves

The rooms include built-in-wardrobes and bathroom shelves, which contain boards and metal-baskets to store clothes.
It shows that the designers originally planned the interior for the rooms, so tenants don't have to obtain wardrobes. As a consequence, not one bulky wardrobe was documented being disposed in the research period.

Figure 5.5: Built in Wardrobes in Rooms of DIK (DIK 2020)

Some of the bathroom shelves are even refurbished, so when they loose color are repainted in the basement. Furthermore, the corridor lamps, which are also original interior, are partly repaired and cleaned for reuse, too. This is mostly done out of personal motivation by the inspector.

On the other hand, two of the metal-baskets and lamps were documented being disposed in the bins, both in a condition that needed little maintenance or refurbishment. Hence it not clear how it is decided, which items are maintained and repaired or disposed, indicating a lack of objective rating criteria. If any of these items can't be maintained or repaired they are easily thrown-out, but if parts of the wardrobes are disposed without being replaced with new items, this furniture system could soon become obsolete.

Old Shelving System

The rooms also include wooden strips on the walls, which once had the function to hang up shelves that were part of the original interior, of which a few are still in use in the basement.

The system consists out of the shelves, wooden strips and wood sticks with metal hooks (see figure 5.6). This allows to hang up a shelve on any place of the walls without the need for permanent attachment through drilling. Again, it becomes clear, that the interior design originally intended to provide the tenants with basic furniture.

Furthermore, all of the found shelves were in a usable condition, even though they are made of MDF boards and have a lifetime of ca. 50 years. Therefore durability of furniture, exemplified with this shelve, is less dependent on the material or the quality of the joints, but more how it is treated, maintained and stored.
But the inspector explained the remaining shelves were just disposed recently: "*We threw them all out, it was an old system and it […] was quite old-fashioned.*" (App.5) and further explained that it doesn't match the aesthetic expectations of the tenants.

Figure 5.6: The previous shelving system of the rooms (photos taken by author)

This shows again the lack of objective criteria, when an item is maintained or disposed. On the other hand, furniture need to be designed so it can be maintained, repaired and refurbished, when temporarily put out of use. Ideally, it is designed so it can aesthetically be updated, e.g. that it can be sanded and painted with a new color.
Furthermore, a system needs to be remanufacturable, when parts disappear or break over time, to avoid systemic obsolescence. A better communication between inspectors and tenants would have also enabled to ask tenants if they want to reuse them, instead of disposing them.

Kitchen Furniture

Due to renovations in all kitchens in 2019, new kitchen furniture was purchased, while the previous one was mostly disposed or left in the common areas of the blocks. The tables' materials were separated into metal and wood and put into the respective waste-containers of DIK. Based on the documentation, most of the tables and chairs had visible wear and tear and therefore needed refurbishment, repair or exchange of parts, but the stable metal-frames would have allowed a longer lifetime, so they were a prematurely disposed considering their durability.

Although the decision to buy new furniture was made by representatives of the tenants the driving purchase factor is economically: "*The new table costed only […] 1500 crones with chairs (6), that's cheap.*" (App.5).
When asked about why the furniture was not repaired or refurbished instead of being replaced, he argued that the costs for putting a new board on the frame would exceed the costs of a new purchase of that price level. Again the labor costs in Denmark for value maintaining practices exceed the costs of new items, making them economically obsolete.

It should also be taken into consideration that the new furniture is not necessarily treated with care by the tenants as some of the new indoor chairs have been left outside during rain, and their legs were partly deformed. (App. 10)
Hence, any furniture commonly used should be robust and designed for repair.

Basement

The interview was followed by a tour through the facilities of the dormitory, such as the basement, to which the tenants don't have access to.

This revealed that there are eight storage rooms of ca. 50 m², which are mostly empty (see figure 5.7), so there are sufficient storage capacities in the dorm. As the writing on the door reads: "*Møbeldepot*", these rooms were originally planned and utilized to store furniture. Hence the architects and designers intended that the rooms are partly furnished and value maintaining practices as storing, cleaning and refurbishing of furniture were planned, too. It seems that this system was phasing out over the course of it's existence (ca. 50 years). Avoiding systemic obsolescence requires to design and plan a system that keeps these value-maintaining practices 'alive' even when staff changes occur.

Figure 5.7: Door of old „Mobeldepot" and empty storage room in the basement (photos taken by author)

Furthermore, in one room, furniture was stored of a previous tenant, who left the dorm without paying his bills. It shows strong signs of misuse, like big scratches on the surfaces of a table and shelve. Hence any kind of solution should take this kind of behavior into consideration for the product design and business model.

Handling of Furniture left by Tenants

One of the central tasks of the inspectors is to clean all common areas inside the blocks and in front of the bins from any kind of waste, such as furniture, a practice which they describe as "*Clean and Silent*" (App. 5).

Furniture left by previous tenants in the common areas of any block, is removed and disposed by them once a month, regardless of the condition, due to fire regulations (App. 5).

Even though the regulation is essential, it also contributes to make furniture obsolete (legislative obsolescence), so storing furniture for reuse should not violate this.

Figure 5.8: Chair removed from block to waste area by inspectors (photos taken by author)

Even though the inspectors are positive towards any solution that would reduce the furniture-waste, they also see challenges for storing furniture, as this would require more staff and the dorm had experienced problems with bedbugs on mattresses and beds.

Furniture in front of the waste-bins

Observations and the interview have shown, that furniture discarded in front of the waste-bins or dorm blocks by previous tenants is disposed as well. The task of the inspectors is not to bring the furniture into reuse, but clean the facilities.
Furniture is either disassembled, separated by material and put into the respective waste-fraction, like the metal waste bins and household-waste bins, if it is small enough or bulky furniture like sofas are brought into a closed furniture-container, to an area that is not accessible for tenants, where also a container for wood is located.

Figure 5.9: Furniture Waste Container at DIK filled with some sofas and beds (photos taken by author)

To summarize, furniture can be put into five different fractions at the dorm, which is handled by three different waste-managers. But only one is designated for furniture, which makes measuring the amount of furniture-waste already at the source of the waste impossible. Many products like mattresses can't be separated and are then put into the fractions for metal-recycling.
Due to their instructions of disposing any left furniture, this practice 'skips' levels in the waste-hierarchy from possible reuse to disposal. Therefore the lack of infrastructure and working force, economic reasons and design faults render furniture obsolete.

5.4 Practices of Tenants of DIK

Facebook – Multifunctional Platform

The online platform Facebook (FB) (2020) in the group *DIK Albertslund* is used for several purposes, as shown in table 5.1.

One of the central functions is to provide tenants with important information about living at DIK in addition to paper notes hanging inside the blocks. DIK hired current tenants (study

board) for communication etc. between the inspectors and the other tenants, which happens through FB, as presented in figure 5.10. People inform and notify each other through 'posts' on this platform.

Hence communication is often indirect, very little information are given when moving in and often just in Danish, which are then clarified here.

As the chart indicates, there are several different topics discussed in this group, but all of them go into only one 'channel', which means every new incoming post is pushing down the previous one.

Figure 5.10: Schema for Communication at DIK (Graphic created by author)

Trade/Marketplace							Other Topics							
Furnit ure- Offer	Furnit ure Requ est	Hous ehold- Item Offer	Hous ehold- Items Requ est	Other items Offer	Other items Requ est	Lendi ng/Bo rrowin g/Sha ring Item	Key/L ocks/ Door s	Some thing Does n't work in dorm	Socia l Issue s/Co mplai nts	Soc ial Eve nt	Subre nting / Rentin g	Other Informat ion Request ed / provide d	Official Information from DIK / Information Requested Living at DIK	Othe rs
Total numbers: Absolute & Percent (300 posts)														
29	8	13	6	21	15	30	6	25	14	6	8	33	56	30
9.7%	2.7%	4.3%	2.0%	7.0%	5.0%	10.0 %	2.0%	8.3%	4.7%	2.0 %	2.7%	11.0%	18.7%	10.0 %

Table 5.1: Overview Topics Posts Facebook Group DIK Albertslund (Reference Chart see App. 12) (Created by Author)

Due to this push-down effect, relatively new posts can quickly be overseen, exemplified when several posts on the exact same topic are send.

In regard of reuse, this platform enables tenants to locally exchange furniture and other items, by offering them for sale, for donations and requesting if these items are for sale, which all make up ca. 30% of the posts.
The platform further enables sharing, e.g. for tools or printing.

The main-reasons when people wanted to sell their furniture, if stated, was 'Move-out'. Often it didn't became clear why people are not moving with their furniture or where they are going to move to, which could influence the likeliness to transport furniture.

Type of Request						Type of Item								
Amou nt of Posts	Want to Sell	Want to buy	Want to give away	Want to Dispo se	Other	Furnit ure in gener al	Sofa	Bed/ Mattr ess	Lamp	Chair / Seat	Shelv e	Desk/ Table	Other s Furnit ure	Other Hous ehold Items
139	87	24	26	4	2	11	16	37	13	23	24	32	16	20
%	~60.8 %	~14.6 %	~15.9 %	~2.4 %	~1.2 %	~5.7 %	~8.3 %	~19.3 %	~6.8 %	~12.0 %	~12.5 %	~16.7 %	~8.3 %	~10.4 %

Table 5.2: Analysis of Facebook Group DIK Albertslund – Furniture Trade (Reference Chart see App. 12) (Created by Author)

But what became clear, is that people want to bring furniture actively into reuse, as selling makes up 60% of the furniture related posts, followed by giving away and wanting to buy,

both ca. 15%, and only few wanted to know how to dispose furniture correctly at DIK (see table 5.2).
It wasn't clear when furniture that was offered, was also sold, but ca. 40 notifications (28.5%) received no responses. The amount of offered furniture, including 'give away', makes up 77% compared to 15% of requested furniture, therefore offer and demand often don't seem to match.
But 16% were willing to give away their furniture for free, either by letting it directly pick-up by someone or by informing the users of the platform where the it has been stored.
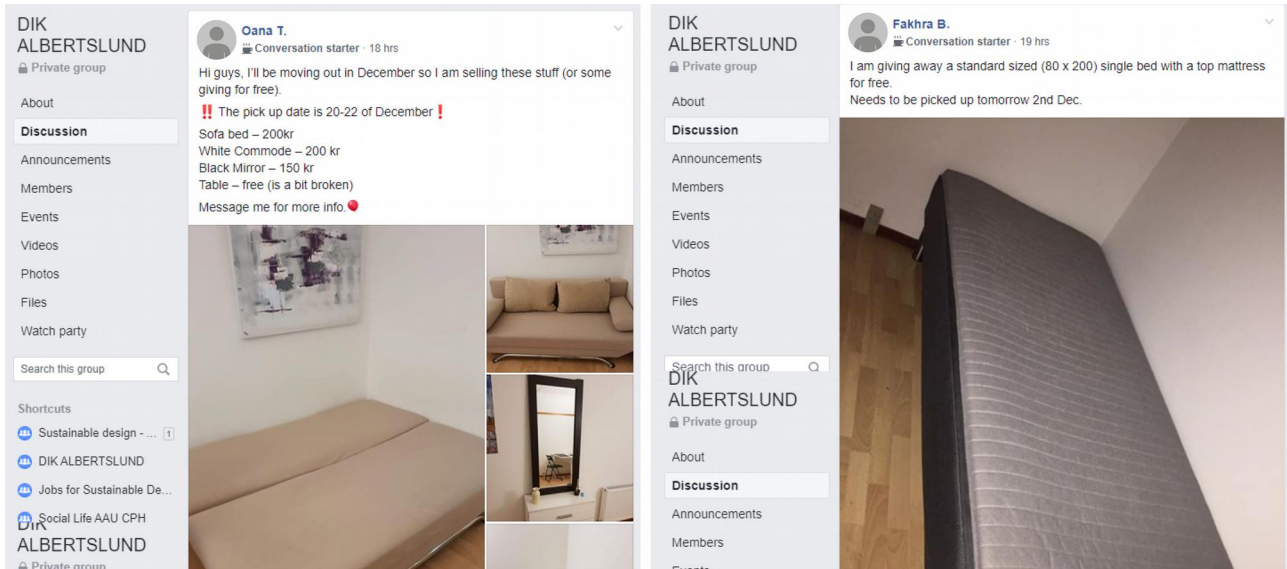
Figure 5.11: Screenshot from DIK Facebook Group - Furniture Offered for Sale (Left) and to Give Away (Right)

Therefore the platform is used to bring furniture actively into reuse, either by receiving monetary reward (selling) or without any reward (donating).

Although a strong correlation between price and response rate was not visible here, price is an influential factor, as unsuccessful sales were often re-advertised with a lowered price. Furthermore when people mentioned the original purchase prices of the products, the resell price was 50% or less, indicating that used furniture has little financial value for sale, here.

Figure 5.12: Screenshot from DIK Facebook Group – Discussion on Bedbugs

The furniture offered and demanded by type, gives an impression which kind of furniture people need for living and how a furnished room should be equipped (table 5.2). Only for beds and mattresses concerns were sometimes articulated towards hygiene, specifically bedbugs, see chat in figure 5.12. The uncertainty if an upholstered furniture is infected with bedbugs hinders the reuse of furniture that might be in perfect condition.
But in general buying used furniture is commonly practiced in this dorm.
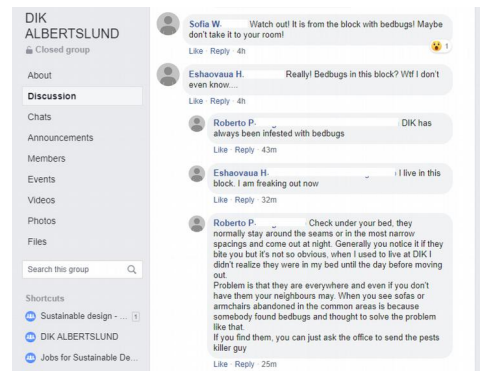
The advertisements which stated how long it has been in use, range from one month to two years, but mostly for only a few months. This indicates that some people live here only for a few month, compared to the estimated residence time of 0.5-1 year by the inspector (App.5).
Another challenge noticed, was the small time-window furniture was offered, as stated (see figure 5.11). Either that the time until it should be picked up was quite predefined, or

from which time on it is available for reuse, as both are linked to the move-out-date. Considering that some furniture is used until move-out-day, like a bed, bringing it earlier into reuse is difficult and thereby allowing only a small time-window to make the transaction.

Only very rarely was furniture, that has been advertised before, later seen in front of the waste-bins. One reason might be that not every tenant uses FB at all or is member of the group, as being a tenant at DIK is not automatically linked to a membership, as a spontaneous interview showed (App.11). And even if people are members there, it doesn't ensure the use of the platform.

<u>Furniture Discarded inside Dorm Blocks</u>

Discarding furniture inside the dorm-blocks seems commonly practiced when tenants move-out, as it was documented, without being the focus it (see methodologies).

Figure 5.13: Furniture Discarded in Dormblock: After a few weeks everything was reused (Photos taken by author)

The advantage of this discarding method is that the dry storage condition keeps furniture in good state for a longer time. After a while, tenants who live in the block and noticed the furniture standing around longer, picked it up for reuse, as visible in figure 5.13 (App. 10).
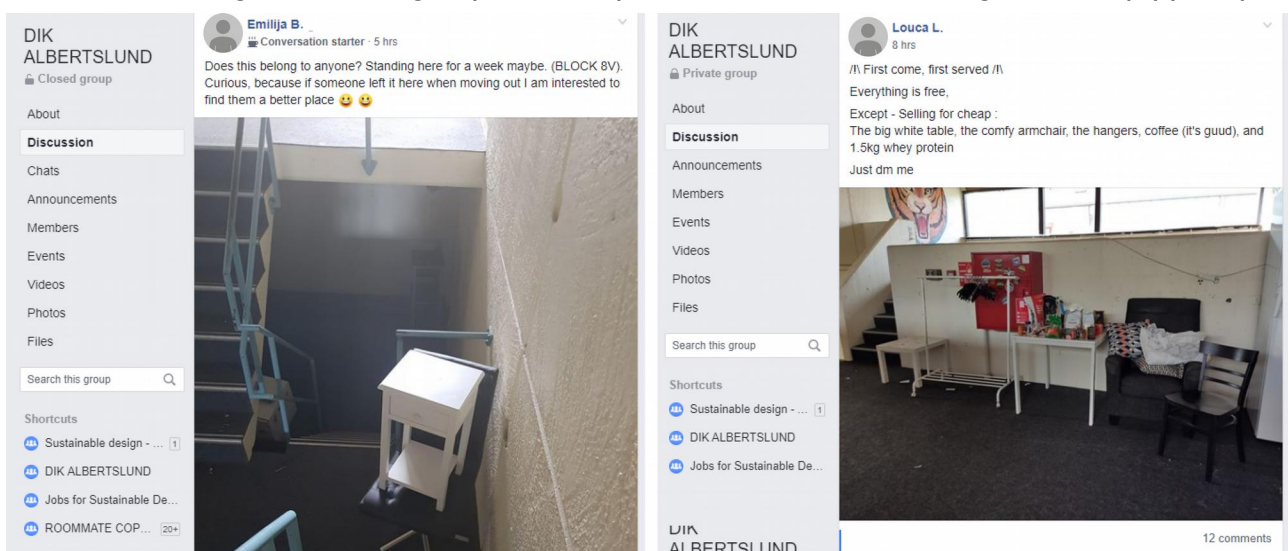
Figure 5.14: Screenshot from DIK Facebook Group –
Leaving Furniture in Dorm-block without notifications (left) & with notification (right)

The disadvantage is that the amount of possible reusers is small, as mainly tenants of the same block can notice it. In addition people were rarely notified on FB or with other notes that it could be reused. Hence, a piece of furniture can stand inside the block for days and weeks before being reused, due to unclear ownership, as reflected in conversations (figure 5.14 left).
This becomes a problem since the inspectors dispose furniture inside the blocks regularly due to the fire-regulations.

Therefore the difference is to bring furniture actively into reuse through notifications, as visible in figure 5.14 (right), donating it to the tenant community. Or people bring it passively into reuse by just leaving and discarding it in the blocks. Both activities can't be quantified, but seem to be practiced regularly at DIK.

Furniture Discarded at Waste-bins:

The most common method to discard furniture when moving out, was leaving it in front of the waste-bins or disposing them inside the bins. Besides furniture, the documentation also included clothes, electronic-items and household-items as they were regularly discarded and disposed, too.

Over the course of 3 months, 164 pieces of furniture or furniture-equipment were documented being discarded (see table 5.3). Furniture-equipment are items used in combination with pieces of furniture as mattress-protectors or clothes-hangers.
The amount of products discarded, shows that the platform is strongly underused to bring them into reuse, as most of it was not advertised before on FB.

Amount	Bed / Bed-frames	Mattre sses	Chairs	Sofas or Sofa-bed	Desks/ Tables	Shelv es	Blinds	Lamps	Carp ets	Othe rs	Furniture-Equipment
164	15	13	16	5	21	17	25	8	7	16	21
100,00%	~9.1%	~7.9%	~9.8%	~3.00%	~12.8%	~10.4 %	~15.2 %	~4.9%	~4.3 %	~9.8 %	~12.8%
Others	3 Woodboards; 3 clothes stand/parts of; 1 Table-Legs; 1 Part from Bed; 1 Piano (Made in Denmark); 4 Mirrors; 1 White board; 1 Foldable wardrobe; 1 Wood frame,										
Furniture-Equipment	1 Pillows (normal, sofa, chair); 2 clothes hangers; 2 Bedclothes; 1 mattresses protector ; 4 Shower equipment (curtain, hose, rail); 1 basket from closet; 1 Floor protector f. desk										

Table 5.3: Overview of Documented Furniture Discarded by Type (Reference Chart see App. 9)
(Created by Author)

A clear outstanding category of items was not noticed, even though furniture used for sleeping, like beds, sofas and mattresses, make up ca. 20%.

Figure 5.15: Typical Pieces of Furniture Discarded: Bed, couch-table and desk (Photos taken by author)

The amount of blinds is also quite high as they are exchanged with every new tenant. Surprisingly, items of high value were discarded, too, like a piano made in Denmark. The brands were not always clearly identifiable, but at least 40 items were identified as IKEA products by label or design. Hence, in this context, IKEA furniture can be considered disposable and a strong contributor to the issue of furniture-waste.

Otherwise the types of furniture discarded indicate what people require for living, consequently how a pre-furnished room could be equipped.

The amount of other disposed items is almost as significant as for furniture (see table 5.4), e.g. 16 bags of clothes were documented. Even though clothes donations container are not on the dorm area, several are nearby, but tenants don's seem to know that (App. 11).

Amount	Household Items	Clothes /Textiles	Electronic Items
166++	65	52	49
100,00%	~38.9%	~31.1%	~29.9%

Table 5.4: Overview of Documented Items discarded besides Furniture
(Reference Chart see App. 9) (Created by Author)

Of higher relevance is the condition and where the items have been placed.
Almost 50% were considered to be directly usable or required cleaning, one quarter needs repair, for ca. 9% only parts can be reused, but only 2% were so damaged that recycling would be the appropriate recovery method. Most of the furniture in a 'not clear' condition are blinds (25), as their functionality was not tested.

Products	Directly usable		Needs Cleaning		Needs repair/ refurbishment		Only Parts usable		Recyclable		Not clear	
	amount	percentage	amount	percentage	amount	percentage	amount	percentage	amount	percentage	amount	percentage
Furniture	20	~12.2%	57	~34.8%	40	~24.4%	15	~9.1%	3	~1.8%	29	~17.7%
Household-items, clothes, electronic items etc.	21	~12.7%	88	~53.3%	8	~4.8%	2	~1.2%	0	0,00%	46	~27.9%

Table 5.5: Condition of Documented Furniture and Household-items Discarded
(Reference Chart see App. 9) (Created by Author)

This statistic (table 5.5.) shows that a vast majority is prematurely discarded and that most of the items are not put into the optimal recovery method.

Figure 5.16: Furniture Exposed to Rain - Shelve from MDF & Leather couch (Photos taken by author)

During the documentation time it often rained, hence much of the discarded furniture became wet and quickly deteriorated in quality, e.g. the laminate of IKEA tables that goes off, MDF that swells or upholstered furniture soaked with water, which renders it as waste, as visible in figure 5.16. Hence it requires dry storage for most furniture to be reused.

The conditions of the other discarded items is almost similar and they would also benefit from dry storage, as electronic items.

Further the place where furniture and other items are discarded seemed to influence the status of becoming waste or not. Besides leaving it inside the dorm-blocks, people had the choice to dispose the products inside the bins or discard them in front or on top of them as summarized in table 5.6.

Products	In bin		In front of bin/on street	
	amount	percentage	amount	percentage
Furniture	36	22.5%	128	77.5%
Household-items, clothes, electronic items etc.	29	~17.6%	136	~82.4%

Table 5.6: Discarding Place of Documented Furniture and Household-items
(Reference Chart see App. 9) (Created by Author)

Most of the documented furniture was discarded in front of the bins, which is also due to their bulky nature. The ones inside the bins were mostly blinds (25) put there by the inspectors. Furthermore only 10 pieces of furniture were discarded in a disassembled condition. This indicates that either people wanted to discard their furniture without much effort or that they wanted it to be reused.
The intention to bring discarded items into reuse is more clearly seen with household-items and clothes, who were sometimes left in front of the bins covered with plastics-bags. Less items were disposed into the bins, which indicates that either the inspectors put them there or that people are not considering reuse over recycling, since the condition and placement challenges reuse.

Figure 5.17: Furniture discarded Assembled & Disassembled (Photos taken by author)

As the majority leaves the items in front or on top of the bins in a usable condition, it can be assumed that they want them to be reused, even though they will quickly be disposed by the inspectors if not reused.

Reuse of Kerbside Furniture

The discarding and reuse of furniture by tenants and disposal by the inspectors was only a few times directly observed (App.10). During weekends people moved and discarded several pieces of furniture, and after a few hours the remaining pieces became fewer and fewer (see figure 5.18). Therefore any piece of discarded furniture that was removed during a time when the inspectors don't work, was considered to be reused by a tenant, which was later confirmed by interviews and the survey.

Figure 5.18: Furniture discarded – Before and after Reuse within ca. 18h (Photos taken by author)

Most of the reused furniture are products like coffee-tables, shelves or desks (see App.9), that are easy to clean. Upholstered items as beds, mattresses and sofas were rarely picked up, except for two carpets and four seats.
Nonetheless the activity of picking up kerbside-furniture seems commonly practiced, showing that tenants are open to reuse used furniture, even when it was exposed to rain and the previous owner was not known.

Products	Yes		No		not clear	
	amount	percentage	amount	percentage	amount	percentage
Furniture	24 1/2	~14.8%	88 1/2	~53.6%	52	~31.5%
Household-items, clothes, electronic items etc.	21	~12.7%	35	~21.2%	110	~66.7%

Table 5.7: Reuse Ratio of Documented Furniture and Household-items Discarded
(Reference Chart see App. 9) (Created by Author)

Furniture and other items that were counted into 'No' reuse, were documented inside the bins and therefore considered waste. The status 'not clear' was given when it has been removed, but not known where. As this was often during a time when the inspectors were working, it was very likely disposed by them and can be considered waste.
Consequently, as visible in table 5.7, the majority of discarded furniture becomes waste, even though the condition would have allowed a longer use time.

Hence the decisive factors that influences reuse of furniture, are the type of furniture and its condition, the place where it was discarded and the timing, so during the work-hours of the inspectors or before it is exposed to rain.

The Different Practices for End of Use Handling and Motives

To summarize, five different practices were identified to treat furniture at the end-of-use: sell on FB, donate through FB, discard inside the blocks, discard in front of the bins and dispose inside the bins. Selling and discarding in front of the bins were documented mostly practiced, but discarding inside the blocks could be done as often, as visualized in figure 5.19.

The motive for selling on FB was not clearly articulated, but is concluded to be monetary reward and an active way to bring products in reuse.

Giving away through FB is seen as an active way to bring it into reuse, too, but without receiving a reward (donating). The motive is reflected in a specific statement: "*Prefer to either sell for a symbolic price or to give it to someone rather than to throw it out.*" *[#110].* Hence the motivation is to bring it into reuse to avoid waste.

Due to interviewing people spontaneously why they discard it in the blocks, one respondent stated: "*I didn't sell my furniture. I just give away to those people who need them most.*" (App.11). Therefore bringing furniture into reuse while doing good can be a motive.
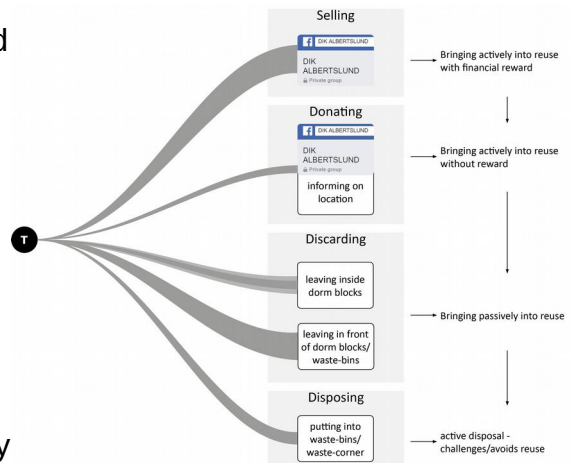
Figure 5.19: Practices of Tenants for Furniture at End-of-Use (Graphic created by author)

On the other hand the majority of furniture was discarded without letting anybody know, so it was brought passively into reuse. Disposing was practiced, too and is partly driven by convenience, as the survey showed. Consequently, several people are disposing products, instead of bringing them into reuse, not acting according to the waste-hierarchy.

5.5 Survey Results

Participants of the survey are mostly students, 20-25 years old and ca. 75% are still living at DIK (App.8). Ca. half of them moved to the dorm within Denmark or Copenhagen, the other half majorly within Europe, whereas two thirds will move after their residence at DIK within Denmark and one third majorly outside of Europe. Two thirds lived at DIK for 6-24 months, the rest shorter or longer, which is in line with the estimated residence time mentioned by the inspector.

Figure 5.20: Graphics Survey Answers Question 5 & 27 (see App.8)

For ca. 75% the room was furnished, like the ones sub-rented by AUAO or by tenants who go abroad. Only 20% of the respondents explicitly don't want a furnished room, whereas 80% would prefer to have furniture under certain conditions, as expressed by one person: "*I would never have bought brand new furniture if the room was already furnished with the essentials, bed frame, table, cabinet, bookshelf and chair.*" (App.8) and ca. half would prefer a furnished room from the sustainable options (Q.38, figure 5.23).

Figure 5.21: Graphics Survey Answers Question 6 & 31 (see App.8)

Ca. one third has not moved to and will not move from DIK with furniture as expressed by one participant: "*I plan to move out of Denmark and i won't take any furniture with me.*" (App.8), showing the correlation between coming and moving from abroad and the challenge to transport furniture. Even though ca. two thirds brought their furniture and will take it with them when moving, ca. one third would benefit from furnished rooms as they will not move with it.
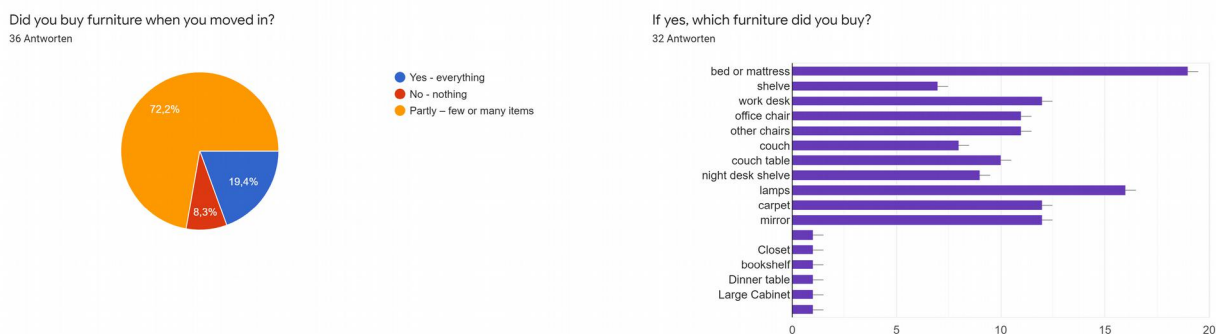
Figure 5.22: Graphics Survey Answers Question 7 & 8 (see App.8)

Consequently more than 90% bought some or all of their furniture when they moved in, which ranges from 1-9 pieces, or even more than 10, for which people spend mostly less than 2000 DKK. The types of items purchased, as visible in figure 5.22 right, shows what kind of furniture is needed for living. Beds are therefore the most consumed, the most disposed and the least reused furniture of this research.

The primary driving factor when purchasing new furniture is the *price*, followed by aspects inherent to the product as *aesthetic, functionality, quality and comfort*, as well as being *easy to transport*. Criteria of little relevance are *environmental consideration* and *brand*. The high influence of price and the little relevance of environmental considerations, especially for young people, is in line with the findings from (Edbring et al. 2016).
When people buy new furniture, it is mostly from IKEA, which confirms findings from the documentation where packaging of this brand was found. On the other hand, brand has little relevance to consumers, therefore IKEA furniture is consumed for other reasons, presumably price.
Hence IKEA is the most consumed, the most sold and the most disposed brand at DIK.

The average use time of furniture can not be pinpointed, but 75% have used it for less

than two years so far, which would be far less than the average life-time of 7-10 years (Montalvo et al. 2016), if not further used.
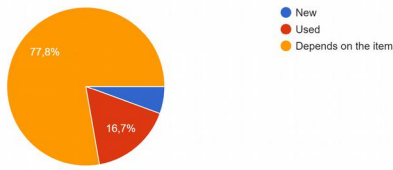
Figure 5.23: Graphics Survey Answers Question 15 & 38 (see App.8)

In general tenants are very open to buy used furniture, prefer it over new furniture, have practiced it already, as ca. two thirds purchased at least one used item for their room and for half of the respondents buying from a local second-hand shop would be the preferred way to obtain sustainable furniture (see figure 5.23).
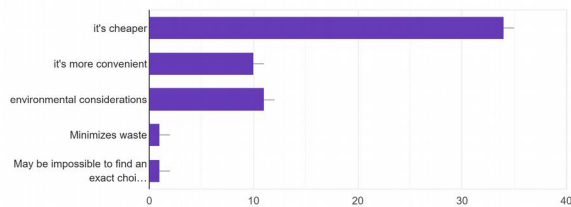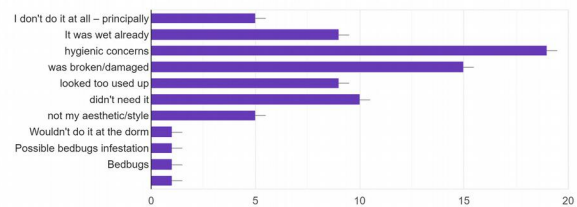
Figure 5.24: Graphics Survey Answers Question 18 & 20 (see App.8)

The survey confirms findings from the observations that tenants, half of the respondents, picked up used furniture discarded in front of dorm (kerbside-furniture).

The biggest challenges to buy or obtain used furniture in any way, are hygienic reasons specifically, repeatedly mentioned, an infection with bed-bugs. This confirms findings from the interview with the inspector and the FB analysis, but is mostly a concern for upholstered furniture as mattresses and carpets. An uptake would be possible if there would be a guarantee that the item is not infected.
Other drawbacks are the condition of the item, as it could be wet or damaged, transport challenges and the lack of variety to choose from.
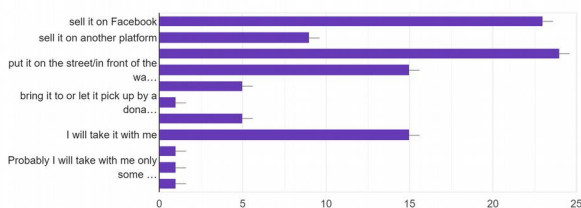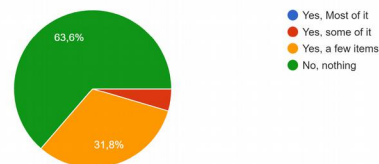
Figure 5.25: Graphics Survey Answers Question 34 & 35 (see App.8)

The biggest driver for any method of obtaining used furniture are by far the low costs, followed by the need to have it, low transport effort when left at the dorm, and the aesthetic. Environmental considerations are more important for used furniture than for new furniture.

The methods for discarding furniture, if people don't take it with them, are selling online, donating to somebody, putting it in front of the bins and disposing it into the bins or at a recycling center, in this order of relevance, which is also reflected in one of the comments.

Even though there is a hierarchy how to discard furniture, observations have shown the differ, that furniture was disposed without previously being offered for sale or donation on FB.

To summarize the biggest drivers for any method to obtain furniture is the price and the biggest challenge to reuse furniture are hygienic concerns. Furthermore obtaining used furniture is more practiced than buying new furniture, according to several statements summarized in figure 5.26.

Consequently a second-hand solution should be local, offer a variety of designs, ensure that the furniture is hygienic and ideally be cheaper than new furniture to gain attention from the tenants. The last three requirements would also apply for a scenario of renting furniture.
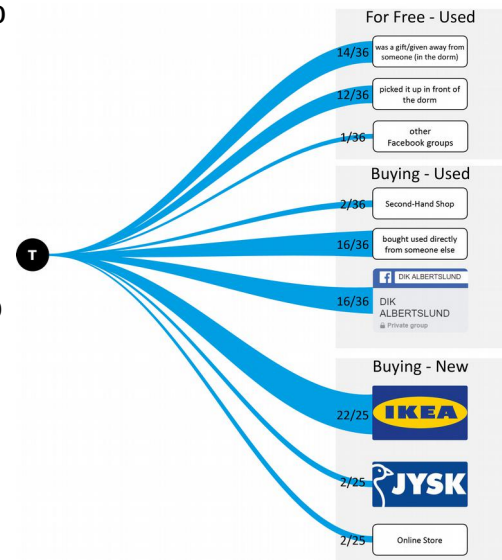
Figure 5.26: Schema Practices to Obtain Furniture by Tenants (based on survey) (Graphic created by author)

5.6 Student Housing Organization KKIK Interview

The email interview with the staff from the responsible SHO, KKIK, brought little valuable information. (App.6) The average residence time of tenants at DIK or of other dorms of KKIK was not clearly answered, nor the amount of waste that is produced at DIK or how much it costs to handle the waste.

The position of KKIK towards furniture-waste is that they don't perceive the problem at all, have not started any solution to reduce furniture-waste and are also not interested to find a solution: "*We don't have a lot of furniture-waste, Many of our students are from Denmark, so they just move to another place, bringing their furnitures. […] We would not be interested (to find a solution).*". The research revealed that tenants of DIK are from Denmark, but a lot are international, who are not moving with furniture to and from the dorm.

Why the rooms are not furnished was not clarified, but she stated that: "*Not many students would prefer to live in a furnished room. Most students want to bring their own furnitures.*" (App.6), which is in opposition to the findings from the survey (App.8, Q.27).

Nonetheless the concerns, that a furnished room would require more workforce, which is not covered with the current staff, and hiring more would increase the rent, are significant challenges and were also mentioned by the inspector. One of the main challenges would be to show if furnished rooms could be long-term more cost-efficient for all parties.

5.7 Furniture-Waste at DIK

To answer the sub-RQ two: '*How much furniture-waste is created at the dorm and how is it handled?*', from the 164 pieces of furniture and furniture-equipment that were discarded (see table 5.3), ca. 140 (85%) were considered disposed and reached the waste-status. This is generated by ca. 60 tenants, according to the estimation of the inspector that 20 people move out every month (App.5). As the amount of discarded furniture only covered one quarter of a year, using the given amount as the average number, ca. 600 pieces of furniture would be wasted every year at DIK. But this is expected to be significantly higher in May or June when the semester is over, as stated by the inspector (App. 5) and tenants (App. 11).
Even though this seems little compared to the 290 kg of solid-waste produced each year by US-college students (ChasingGreen 2011), it present only the minmimal amount of waste, which was documented and could therefore be much higher.

According to the inspectors the two main disposal places for furniture, the furniture container and metal waste corner, are emptied three to four times and one time a year, respectively. In total ca. 105 to 135 m³ of furniture are estimated to be disposed at DIK (App. 6). But since furniture is already at the dorm put into three additional waste-fractions and the given numbers present only estimations, the amount of furniture-waste is most likely higher. Which confirms findings from (Larsen et al. 2012) that the amount of waste becomes unclear due to being put into different fractions. Furthermore, this research counted the amount by pieces and the estimations from the inspectors result in volume (m³), which allows little comparison to the amount by weight in kg used by literature.

Besides the documented 166 household-items, electronics and clothes, the inspectors also mentioned that ca. 60 bicycles are left by previous tenants every year. Hence it is not only furniture waste, which is a problem at the dorm, as acknowledged by both inspectors, but also several other items are regularly and prematurely disposed, turning this dorm into a 'waste-machinery'.
On the other hand, the problem is not seen, as stated multiple times, or acknowledged by the responsible SHO, KKIK. It is not clear why they don't perceive it, but I assume, as long as the problem is not directly observed, doesn't appear in any statistic or doesn't present a significant cost item, it can't be acknowledged and consequently not tried to be solved.

How furniture-waste is handled in Albertslund municipality and for the dorm has not become clear as none of the three responsible waste-managers answered any question, either since they didn't respond or stated that DIK is not their customer (App.16). Vestforbrænding is responsible for handling several waste-streams of the municipality and the dorm, such as furniture, but doesn't measure and explain the treatment of furniture-waste in their annual report (App. 13). A repeated interview request via. Email was ignored and in personal contact, the responsible staff was first positive about answering questions which was then turned down via email (App. 16).
Therefore the end-of-life treatment for furniture was not clarified through primary research. Considering the condition of the discarded items, they are often put into the wrong recovery method. Instead of being reused, repaired etc., they are put into containers which most likely lead to downcycling and incineration and to a small degree to recycling, as researched by Fuentes (2017) in Copenhagen, which is also assumed by the inspectors and other interviewees (App.5 & 14).

5.8 Aalborg University Accommodation Office Interview

Aalborg University Accommodation Office (AUAO) is subrenting furnished rooms at DIK to international students for half to one year. This includes one bed, table, chair, blind, shower curtain, wastebasket and lamp. For providing this service AUAO charges 300 DKK extra per month to cover the costs for maintenance and purchase of new furniture, which is a non-profit fee, as they are not allowed to monetize this.
The main motivation to provide an accommodation is to make it convenient for the students to arrive in Denmark and start their studies as the social registration is linked to having an accommodation beforehand. The responsible staff explained the idea to rent furnished rooms: "*an international students will not be flying over with a bed or table. And if it's an exchange student, who is here for 6 months it doesn't make sense that he or she has to buy it.*" (App.4). Therefore, mainly this user group would benefit from renting prefurnished rooms at DIK.

AUAO also previously sub-rented rooms in another dorm in Copenhagen municipality, but the legislative framework was changed, so it is not allowed to subrent student rooms, which is still possible in Albertslund municipality. Therefore, more furniture for short-term living could be purchased and discarded, hence would become obsolete through this legislation.
AUAO's sustainable agenda with furniture is mostly based on personal motivation and initiative of the responsible staff, Deborah. This includes repairing of furniture when possible, keeping parts of disposed furniture as spare, purchasing according to EU Eco-Labels, storing surplus furniture, reusing furniture from the university and cleaning rather than disposing. A clear guideline from the university or a GPP would allow to have objective purchase criteria and a respective budget, instead of making these decisions by subjective criteria of one person.

Nonetheless decisions are also made based on economic criteria, therefore most furniture is purchased at low price retailers IKEA and Jysk. Additionally, shower curtains and a mattress-protector are renewed with every student to fulfill hygienic standards. Cleaning is not practiced with these items as the labor costs would exceed the purchase of new items, making them economically obsolete.

Further circumstances that make furniture obsolete is the behavior of the users coupled with the design. AUAO experienced a misuse of shelves, baskets and toilets, as they were not cleaned the appropriate way, which already lead to premature disposal of these items. Like shelves, which had damaged surfaces from stains, were then disposed.

To summarize, providing these services requires sufficient staff to maintain, repair, transport, store and obtain furniture. Accordingly, design criteria for a renting scenario are: easy to clean, design for hygiene, repairable, providing spare parts, design for durability, robust surfaces and design for space-saving transport and storage.
Furthermore their fee sets the price level for the service in a non-profit scenario and the types of furniture provided define the basic equipment a room should be furnished with.

5.9 Albertslund Genbrugsstation - Findings

Albertslund Genbrugsstation (AGS) is a HWRC located ca. 2 km from DIK. The recycling center sorts different types of bulky waste, such as furniture, or special household-items.

Several reuse initiatives for different types of products have been implemented at AGS, as expressed by one employee: "*We try to re-use as much as possible.*" (App. 14).

For furniture they have a special room (*Møbler*), where people leave their items, instead of disposing them into the waste-containers, so other people could reuse it for free. This has a social function, as it enables less wealthy people to obtain goods. But it also shows, that AGS acts according to the waste-hierarchy where preparation for reuse of products and materials is put over recycling and waste-treatment, confirming some findings by Fuentes' (2017).

Figure 5.27: Albertslund Genbrugsstation - Inititative for Reuse of Furniture: Møbler (Photos taken by author)

The challenges to bring furniture here into reuse, are that customers need to be informed about the reuse room, which is done via signs and by the 2 to 3 employees per shift. Hence when customers place their furniture in the waste-container, the staff is very engaged, but limited in capacity, to replace usable furniture in the *Møbler* room. But also customers place furniture into the reuse room, which the staff considers not reusable. Ca. half of the furniture put into the *Møbler* room is reused according to the employee (App. 14).

Recycling for indoor furniture happens through different waste-streams, as it can be put into three containers: Upholstered Furniture (*Polstrede Møbler Lineoleum*), Unpainted Indoor-wood (*Umalet Indendørstræer*) and metal, as visible in figure 5.28.

The way employees decide in which fraction to put the various types of furniture, the interviewee said: "*It's decided by what's mostly included.*" and further explained that they often don't have the time to separate the materials. Hence a chair which has a metal base, will be put into the metal container, even though it also contains leather, upholstery and plastic. The nature of furniture consisting of mixed materials, which are often not

separable, results in putting it into the wrong waste-stream. Therefore recycling is most likely not done appropriate to the material and can result in downcycling (Fuentes 2017).

Figure 5.28: Albertslund Genbrugsstation - Recycling Containers for indoor Furniture:
(from left to right) Upholstered, Metal and wood (Photos taken by author)

The container with wood also shows that the mechanical treatment doesn't allow to recycle it into a material of equal value, but rather downcycle it into strand- or particle-boards. This underlines the importance of the design criteria disassembly and material-purity to enable recycling (Bärsch et al. 2001) within the current waste-infrastructure.

The amount of waste is not measured here and the responsible waste-manager, *Vestforbraending*, didn't answer any questions. Therefore it remains unclear how they treat furniture-waste, but one employee of AGS stated: "*A lot of it would be burned.*". Incineration is a very likely treatment method as desk research has shown (Fuentes 2017) (Forrest et al. 2017).

The challenge to bring furniture into reuse and use this service from the perspective of DIK tenants is, that you need a transport vehicle and that no information at DIK are presented about AGS and only few of the survey respondents knew about this place and service. A stronger cooperation between DIK and AGS could reduce the amount of wasted furniture at DIK.

5.10 Agenda Center Albertslund Interview

This interview was held with Agenda Center Albertslund (ACA) on behalf of the municipality, which referred the author to ACA, as they work closely with each other. The municipality was not contacted again, as they showed little interest in a cooperation.

As part of the interview, the report of the local waste-managers Vestforbraending (2018), which was only in Danish, was skimmed for valuable information, e.g. how much furniture-waste occurs in the municipality and how it is treated. It doesn't provide information on furniture, as this waste-stream, *Storskrald* (Bulky-waste), is not measured, which also can't be explained by the interviewee or the municipality. Further ambiguity was created as it is

not clear in which fraction furniture is put in, which was later clarified at AGS. The report states that ca. 58% of all waste fractions is recycled and 37% incinerated, but gives no specific information for the treatment of furniture (Vestforbraending 2018, 3).

The missing presence of local second-hand furniture-shops was explained due to the high rents in Albertslund center, as the properties are privately owned. Instead, second-hand online platforms, like DBA or Facebook are used in Albertslund to sell or give away furniture. Further she explained that some neighborhoods also have storage rooms, where people can leave furniture, so somebody else can reuse it for free. According to her, this kind of solution would also be possible from a legislative point of view at DIK, even though she knows that this would result in additional work-hours to handle storage and avoid filling these rooms with unusable items.

5.11 Red-Cross Store Interview

The only local second-hand store in Albertslund is from the charity organization Red-Cross (RC). By interviewing one of their employees (App. 15), it became clear, that furniture is not sold there, as they don't have enough space to store these bulky products. Additionally the high weight of furniture would be challenging to handle for the employees, who are mostly elderly women.
Hence furniture suitable for reuse in commercial second-hand shops should be designed so it can be stored space-saving and easily handled through lightweight design.

She further explained that all employees are volunteers, except some staff at the headquarter and that this job is also important for her to socialize with other people.
She also mentioned that the nearest by second-hand shop for furniture is one train-station away at Taastrup.

The advertisement of this store happens through a local newspaper on an irregular basis, their homepage and FB, but targeted advertisements in the dorm are not done.
Even though surveyed tenants knew about the shop, the discarding behavior and an interview (App.11) showed that this doesn't include everybody. Hence a stronger communication and cooperation between the shop and DIK could help to reduce at least the amount of disposed clothes, household-items and electronics.

6.Discussion

6.1 Summary Central Problems of Case-Study

The reason why furniture, in the Danish dormitory DIK, becomes waste are the sum of several interlinked problems, answering the main RQ '*What are the influential factors that make furniture become waste and how do they need to change to implement a circular solution in a Danish dormitory environment?*'.

Unfurnished Rooms, Short Residence Time & Tenants from abroad

Due to the fact that 96% of the rooms at DIK are rented without furniture, but a share of tenants comes from abroad and goes abroad, furniture is obtained specifically for the stay

at DIK, but not transported afterwards. In addition the residence time is short and can vary between a few month and several years, but is most often between half a year and two years, according to the inspectors (App.5) and the survey (App.8). Therefore tenants purchase new or used furniture, that is possibly used for only a few months, which can also lead to short life-times when it is not brought into reuse. It is very likely that under these circumstances the average lifetime of furniture is not 7-10 years (Montalvo et al. 2016), but rather less than two years (App.8).

Additionally furniture is often needed until the move-out day, therefore leaves only a short time-window for bringing it actively into reuse.

Research has shown that it is very undesirable to have short use-time for furniture, as the highest environmental impact occurs in material-extraction and production and is quasi not existent in use (JRC 2013), therefore the impact per year decreases the longer it is in use (Ingham 2011).

Logistic Obsolescence

One of the central reasons when people were selling or giving away their furniture was due to 'move-out', hence they can't or don't want to transport their furniture, making it logistically obsolete, which was already researched (Hebrok 2016) (De Spiegeleir 2019). One third of the surveyed tenants moved outside of Denmark or Europe and could therefore not transport their furniture, but people who stay within Denmark and move by car could potentially do so. To avoid that furniture is disposed due to challenges of transport, it should be designed so it can be transported space-saving to enable more cost-efficient move.

Material Obsolescence & Design Flaws

Several of the discarded furniture were made from man-made woods, as particle or dust-boards. Some of these were showing material-breakage, as they had cracks in the middle of the board and were even tried to be repaired by the previous owner. Other particle-boards were laminated, which easily goes off and is not made to sustain wear and tear. When these materials are exposed to rain, they quickly swelled and deteriorated in quality (see figure 6.1), whereas furniture made from solid wood showed stronger resistance and therefore expand the time-window for reuse.

The lack of material resistance was also mentioned by AUAO, as shelves were thrown out due irreversible surface damage.

Hence materials used in modern furniture showed to be less durable, are not made to be easily repaired and have surfaces that are not resistant to wear and tear and could not easily be refurbished, as already researched (Hebrok 2014) (Fuentes 2017).

Another design-related problem is that components are not exchangeable, therefore when one part breaks, often the whole product needs to be disposed as observed with discarded chairs, of which only the backrest was malfunctioning. AUAO disposes beds, which are not repairable or spare-parts are missing, too, as well as the inspectors of DIK with several products, specifically window-blinds.

Figure 6.1: Discarded Products: Coffee-table from laminated chip-board (left); Sofa made from Particle-board with material-breakage (middle) & Sofa made from multiple materials (right) (Photos taken by author)

The disposed beds by tenants showed a similar problem, many had a design where mattress, frame, slatted frame, suspension and upholstery are all one, permanently attached part (see figure 6.2). Hence when one part is damaged, used up or unhygienic, the whole bed is disposed instead of just the one part. This challenges reuse of beds immensely as stated: "*I would probably pick up a frame for a bed, but not the mattress*" (App.8).

Figure 6.2: Discarded Bed – Materials permanently attached (left & middle) &
Mattress disassembled into cover, springs and upholstery (Photos taken by author)

Hygienic concerns, specifically bedbugs, are by far the biggest challenge for reuse of upholstered furniture. This is in line with findings from (Edbring et al. 2016), that furniture with textiles is rarely reused due to hygienic concerns. Furniture that would allow to detach parts of hygienic concern to clean them properly, could enable reuse of these items, as it could also be the case for mattresses, see figure 6.2 (right).

Furthermore, furniture showed to be a mix of several materials, as exemplified by a sofa, which was so damaged that you could see the inside, which revealed a composition of 9 different materials (see figure 6.1 right). As researched by Bärsch et al. (2001), mixed materials that are permanently attached to each other, challenge value maintaining recycling, hence the design of the furniture presents a technological lock-in that leads to downcycling or incineration.

Design that allows to repair the furniture by the users (self-repair), giving access to repair-services and spare-parts, the use of materials that are durable, can be repaired and

refurbished, design that allows exchanging parts when they break or become unhygienic, could counteract material obsolescence.

Systemic Obsolescence

When the dorm was build and planned, the rooms were partly furnished, as it contained shelves for the wall, and still contains a built-in wardrobe and bathroom shelve. But the shelving system already became obsolete as it was not properly maintained and remanufactured. While some bathroom shelves are maintained by repainting them, parts of the wardrobe like the metal-baskets are disposed without going to be replaced with a similar product. Hence, this built-in furniture-system can become obsolete when parts are not repaired or replaced.
Design for repair, refubishment and remanufacture can counteract this systemic obsolescence (Medkova et al. 2016).

Aesthetic Obsolescence

Aesthetic obsolescence in regard of replacement due to being out of fashion was rarely notified as a reason when people were selling or giving away their furniture on FB. Even though one spontaneous interview showed that a carpet was discarded since it didn't match aesthetic expectations. On the other hand a lack of choice for aesthetic and 'not my style' were mentioned as challenges to reuse furniture from shops or as kerbside-furniture in the survey. Out of fashion was a reason to dispose the shelving system by the inspector, even though he is not the user group.
Literature explains the increasing influence of fashion obsolescence for furniture (Penty 2020), which could also be the case in this use scenario, but was not uncovered.
The other type of aesthetic obsolescence, that furniture looked used up, was observed with discarded furniture and stated as a reason for not being reused by survey participants and is therefore of higher relevance.

Emotional Obsolescence

Two examples showed contrasting influences of emotions attached to furniture. On the one hand a respondent of the survey stated: "*I have used the same furniture since i was 13*" and "*A gift from my mother*". Hence emotional attachment due to being a gift from a family member can extend the use-time (App. 8).
On the other hand, a spontaneous interview revealed that one tenant discarded a carpet due to aesthetics, even though he got it from his mother's home (App.11).
Hence the influence of emotions is not clearly evidenced to extend the use- and lifetime of furniture, as already researched by Hebrok (2014).

Economic Obsolescence

One of the strongest contributors that renders furniture waste, are economic reasons. The comparably low price of new furniture and not significantly high costs for end-of-life handling together, easily exceed the costs for maintaining the condition and value of furniture, confirming findings by (Forrest et al. 2017).
Specifically, many pieces of furniture, mostly smaller items as blinds, shower curtains and baskets are not cleaned, as the labor costs would exceed the costs of new items. At DIK this also challenges a possible storage of furniture discarded by tenants. Even though the

storage capacities in the basement are there, the handling of it would require more staff and therefore would increase the rent for the tenants, hence make them economically obsolete. Common furniture that would have required refurbishment, repair or exchange of parts, was instead disposed, because it is cheaper to buy new furniture. Although the employees of DIK and AUAO are practicing value maintaining activities, as much as possible, as soon as they exceed the available work-hours and therefore a certain cost-limit, they are not performed and the products become economically obsolete and are disposed, confirming findings from Hebrok (2014). These costs don't allow people to act according to the waste-hierarchy.
A shift in labor taxation through EPRs (FPRCR 2015) could support these activities.

Additionally, none of the responsible stakeholders was able to specify the costs for waste-handling of furniture, as they are included in the taxes and the rent (App.5), therefore are not broken down and can't be perceived as a problem.

This situation creates an economic lock-in as the unsustainable practices will be continuously preferred over the sustainable ones, as they are more economically profitable. This practice is expected to proceed, unless a price regulation would be implemented, through various economic instruments of an EPR, that would reflect the real price of the environmental damage a product creates.
Further influences of economic obsolescence are that reuse can't occur in commercial second-hand shops if it wouldn't be based on voluntary work and donations, confirming findings from Curran et al. (2010).
In Albertslund reuse is not possible at all as the high rents for properties don't allow to rent stores of a size that could offer furniture.
Additionally, furniture which was offered for sale on FB had little resell value and low-price furniture, e.g. from IKEA, was discarded instead of being offered for sale.

Missing Criteria How to handle Furniture

The employees of AUAO and DIK, seemed to lack clear criteria from their superior organization how to handle furniture, therefore it is not treated according to the waste-hierarchy.
The green purchase criteria and activities to extend the life of furniture from AUAO are only driven by personal motivation and the decisions made by the inspectors which furniture to dispose or maintain seem to be randomly made and less by coherent criteria. To avoid shortening furniture's lifetime based on subjective criteria of individuals, a GPP or improved consumer labels could guide this process and give objective, 'green' purchase criteria (Forrest et al. 2017).

Communication:

The existing platform for communication, FB, is not used by everybody to bring products into reuse, as discarded furniture inside the blocks or in front of the bins has rarely been advertised before or after it was discarded.
This can lead to the furniture being disposed by the inspectors before being reused, since they go through the blocks once a month to dispose all furniture, due to fire-regulations. Therefore it could be left there for only one day, but still be disposed. Instead the inspectors could give a notification that it needs to be removed within a certain time, but this would require their active participation on the existing online-platform and that it

enables such a function.

Hence the functionality of the platform is limited to bring furniture into reuse and additionally it is not used or known by every tenant and not everybody is a group member. Additionally Facebook is known to make money to sell personal data of their users and should therefore be avoided to be used.

Legislative Obsolescence

The main reason why furniture can't be left inside the dorm blocks is that this would violate the fire-regulations. A storage solution should avoid violating these regulations, e.g. not in living areas, and would be welcomed by the inspectors.

Furthermore, Deborah from AUAO explained that the shower curtain and the top mattress covering is replaced with every new tenant due to fulfilling hygienic standards. Fulfilling these standards could also be achieved through cleaning, which requires cleanable products and time designated to these activities.

Thirdly, the different legislation in the municipalities Albertslund and Copenhagen enable universities to either sub-rent dorm rooms with furniture or not, respectively. Therefore AUAO had to give up on rooms in another dorm. Hence fewer furnished rooms are available for international students who might come to Denmark only for a short time and therefore need to obtain and discard furniture for their rooms. This legislation needs to be adapted so universities could provide this service, e.g. when they proof that this is a non-profit service as that of AUAO.

Handling of Furniture by Tenants

On the one hand, furniture is not actively brought into reuse by multiple tenants as it is discarded instead of being sold or donated, sometimes also in a condition that challenges reuse, like disassembled bed-frames. The current behavior is mostly not in accordance with the waste-hierarchy were furniture is discarded and disposed instead of brought into reuse, also due to the lack of 'legal' storage space.

Figure 6.3: Discarded Items: Piano & disassembled Bed-frame; Chair destroyed (Photos taken by author)

Not taking over responsibility for handling the end-of-use of products becomes specifically present with the discarded piano (see figure 6.3). It also exemplifies the that people should questions their consumption behavior, in terms of 'Do I need this item for living?'. Unthoughtful purchases were also mentioned by Gordon (2007) as a contributor to waste. The lack of responsibility is more apparent with household-items, bikes and clothes which were disposed event though a respective shop and clothing containers are nearby.
On the other hand, mistreat of common and individual furniture was documented, in addition to furniture standing in front of the dorm that was damaged, unintentionally or intentionally. Hence any kind of solution needs to take user behavior with furniture into consideration and find a way that makes renting furniture attractive for all parties, while still holding users to a certain degree responsible for possible occurring damage.

Waste-Management

Vestforbraending was identified as the responsible waste-management for furniture by multiple interviewees, but they were not able or willing to state how much waste is collected and how it is treated, which could therefore only be estimated.
Therefore furniture remains currently an unmeasured and in statistics hidden waste-stream, which is incomprehensible, as for furniture-waste specific containers at DIK and the AGS were put up, even though furniture is also disposed in other containers. This could be changed by implementing a duty to provide information on the amount and treatment of furniture-waste to the public, as it is them who pay for the treatment.

Nonetheless the HWRC has implemented several initiatives that prefers reuse over recycling, which is in line with the waste-hierarchy.
Several interviewees estimated that furniture is incinerated, this end-of-life treatment would be in line with findings from literature, that the majority of materials incinerated or downcycled and only metal is recycled (Fuentes 2017) (Forrest et al. 2017). This is also caused by the nature of furniture, consisting of multiple, permanently attached materials (Bärsch et al. 2001), like metal, wood, textiles and hard-plastics. Therefore the recycling methods need to change, as well as the design to enable separation of materials, which both present mutually reinforcing technological lock-ins.

Producers need to be held more responsible for the end-of-life treatment through the implementation of EPR instruments (FPRCR 2015).
Getting furniture into the waste-system should be avoided due to the immense value-loss, therefore any solution higher in the waste-hierarchy, like extending use should be supported.

Waste-Problem is not Recognized

The interview with KKIK has shown that they don't recognize the problem of furniture-waste. This is contrast to people who perceive this problem in situ, e.g. participants of my survey and the inspectors of DIK. As no statistics are available about the dorm on the amount of waste generated and how much it costs, awareness on the significance of the problem can't be created.
Consequently the implementation of a duty to provide information would allow to perceive the problem. Furthermore, if the treatment of waste, e.g. by implementing an incineration fee, would become much more costly, I assume the problem would more likely be perceived and solved.

6.2 Circularity of Industry

Answering sub-RQ one: '*How linear or circular is the furniture industry and their products?*', it is hard to pinpoint the level of circularity in the furniture industry based on the given data.
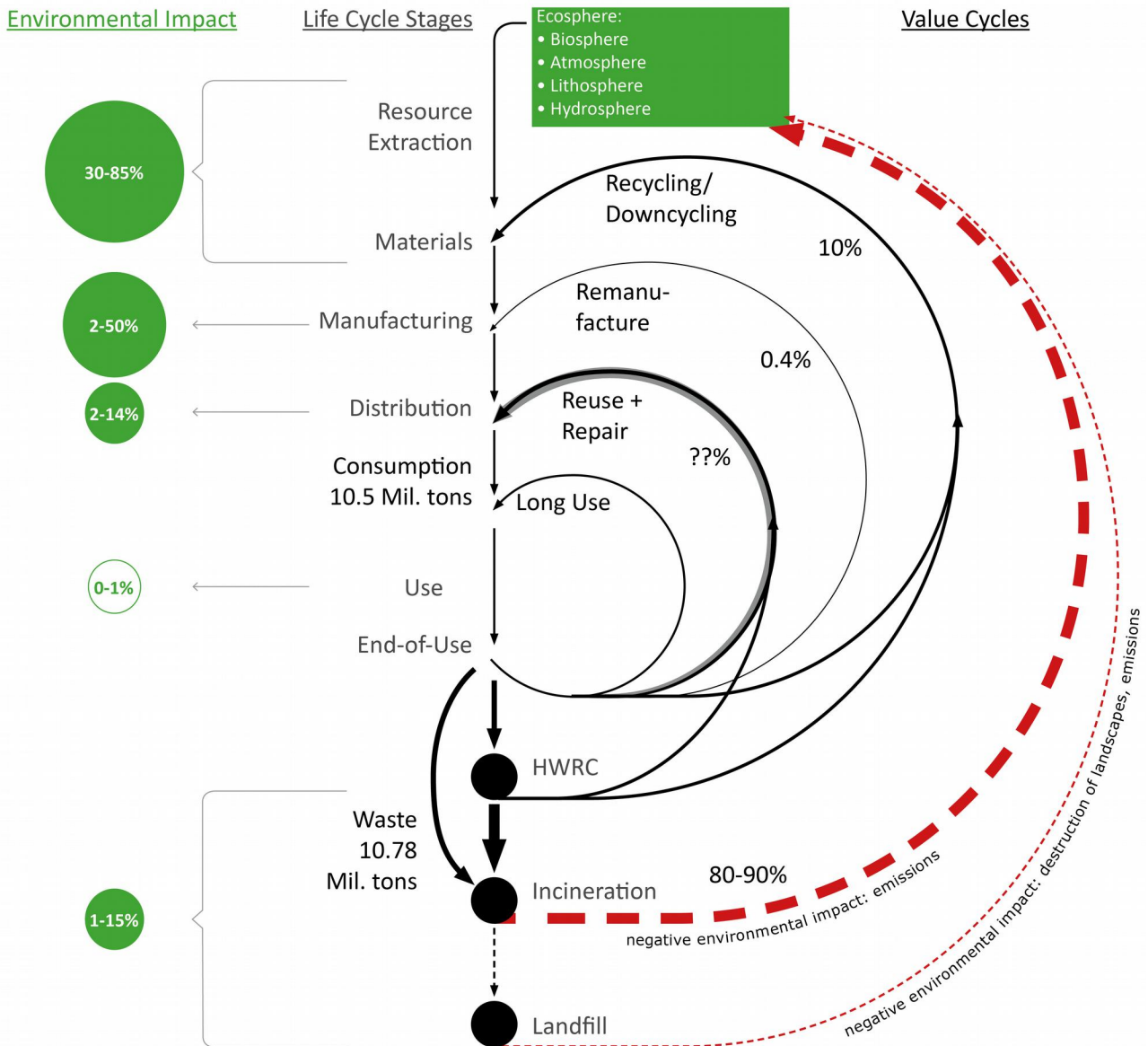
Figure 6.4 : The Furniture Industry Level of Circularity Status Quo (Graphic Created by Author)

But thanks to the literature review it became clear that the strongest environmental impact according to the life-phases of furniture is in material extraction and production and to a smaller degree at the end-of-life, whereas the use phase is almost not having any impact (JRC 2013). Nonetheless, the current lifetime of 7-10 years (Montalvo et al. 2016) is not exploiting it's full potential and is shorter than in the past (Renda et al. 2014).

The share of sustainable or circular companies on the industry is also not clear, but circular furniture is yet considered a niche market (FURN 360, 2018), like it appears mostly in the office sector (Penty 2020). Therefore, despite the small share of furniture giants like IKEA by company numbers, they have a huge market share (Renda et al. 2014).
The sub-sector second-hand and repair are hard to quantify as they are not represented in

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official statistics, even though several ten-thousand people are working in reuse networks (EEA 2018). Despite the social agenda, it is clear that the the reuse sector heavily relies on voluntary work and donations (Curran et al. 2010) and would therefore most likely not exists without these support mechanisms. The remanufacturing sector is the only one to pinpoint, but makes up just 0.4% of the industry's economy (Parker et al. 2015).

The furniture sector seems to lack keeping track of their products after being manufactured and sold. Even though HWRC can lead to reuse, at the end-of-life, only 10% of furniture is recycled, mostly metal, and it occurs downcycling is rather common, but the majority is incinerated or landfilled (80-90%) (Forrest et al. 2017).
Therefore the furniture sector in the EU seems mostly to follow the linear economy model, as visualized in figure 6.4.

6.3 Solutions for Case-study

To answer sub-RQ three: '*Which circular furniture-design solution(s) could reduce the amount of waste at the dorm?*', several options are conceivable inspired by the circular alternatives in the furniture sector.

The main threshold for the uptake of sustainable practices were economic challenges, but under the current circumstances, any solution would be more expensive than current linear design. Therefore CE practices and designs need to be supported by the implementation of several economic instruments through a mandatory EPR, such as a labor taxation according to the waste-hierarchy, direct governmental funds and more expensive end-of-life treatment, e.g. fees according to the waste-hierarchy. An increase in the rent seems also unavoidable, but labor is also set free by switching from disposal to value-maintaining practices. Furthermore, it is necessary that KKIK acknowledges the problem and develops an interest to solve it, before any solution could be initiated. A mandatory documentation of this waste-stream by amount, type of treatment and occurring costs could support this.

A solution that shouldn't be implemented, but could reduce the total amount of waste by weight would be cardboard-furniture. Even though it is known for its short lifespan (Vezzoli & Manzini 2008), research has shown this is currently the case with furniture at DIK. Therefore reducing waste by using a lightweight, low-impact and highly recyclable material would only slightly improve the situation, which is additionally limited in its functionality and application potential.

6.3.1 New Online-Platform for DIK

A new online-platform or app that would replace FB, for which every tenant would automatically get an account for when moving in. It should have different functions, organized in 'channels', such as basic information when moving in, official announcements from DIK, giving information where to obtain furniture or the marketplace function to sell or give away of products like furniture. A permanent 'attachment' of the notification could enable a longer visibility and increase the chances to bring products into reuse.
This could be an adapted version of the current website or an account of the online-platform *Off2Off* (Kiørboe et al. 2015).

It could also enable better reuse of furniture discarded inside the blocks, since tenants and

inspectors would notify other tenants which items have been placed and where it is located. To avoid violation against the fire-regulations, each piece can stand there for a limited duration, therefore the app gives information, when it has been placed, too. Therefore furniture is only disposed when it exceeded the max. storage period and it should be clearly communicated that furniture is allowed to be temporarily stored in the common areas.

When more people of the dorm are informed that products can be reused, the chances increase it will be reused instead of disposed.

This solution is the least effortful, as it doesn't necessarily require more work-force or changes of the facilities. The implementation of such a platform would be costly at the beginning, but could be covered through lower costs for waste-management and EPR instruments etc.

The goal is to increase the participation by giving automatic accounts and make it more easy to discard furniture without violating against fire-regulations. The temporary storage would increase the time-window for reuse by storing it under dry conditions. Nonetheless, it will be challenging to motivate the tenants and inspectors to change their practices from discarding and disposing furniture to using the platform to inform other people on the reusable products.

6.3.2 Storage Solution – Containers

Another way to avoid violating against fire-regulations and increasing storage time under weather-proof conditions, would be setting up storage containers.
This solution is inspired by concepts as the *Møbler* room at AGS or the *Byttecenter* (Fuentes 2017).

Tenants who don't bring their furniture actively into reuse, can use these storage containers to leave their items there, instead of in front of the waste-bins, when moving out. This is in line with the current, convenience driven, discarding practices and would still enable to bring it passively into reuse.
The storage containers would have the same lock-system as the dorm-blocks, so no extra keys are necessary to enter and could be placed on the parking lot, which has sufficient space capacities. A storage of furniture in the basement is not suitable, as only the inspectors and the study-board should have access to it.

On the other hand, it requires work-force to clean and reorganize these containers from time to time, which would either be done by the tenants or by additionally hired staff.
The main challenge will be the investment in these weather-proof containers, which needs to be supported by one or several of the previously mentioned economic instruments.

6.2.3 Second-hand Shop for Furniture Lead by Tenants of DIK

A second-hand shop for furniture and other discarded items as integral part of the dorm lead by their tenants, could reduce the amount of disposed products, extend their life-time and reduce the consumption of new products.
This concept is already practiced in the Netherlands (De Spiegeleir 2019) and the USA (Peak 2015). It is desired by half of the surveyed tenants and is in line with their practices of obtaining used furniture.
This solution is also about extending the storage time until the furniture gets possibly

reused, hence increasing the chance to match offer and demand. Since the dorm has huge storage capacities in the basement, the challenges is rather to provide sufficient, authorized staff to handle the storage and organization of the products.

Hiring students could provide the necessary labor, whereas the reliance on voluntary work like in the reuse sector should be avoided. Some tenants work already at the dorm at the study-board and other have student-jobs, hence this could be an economic benefit for several parties with little effort.

The business would be funded through donations of furniture left by tenants, because buying them from tenants, could increase the overall price of used furniture drastically. This non-profit service should only cover the labor costs through revenue streams of the sold products.

The employees would collect all discarded furniture on a regular basis and afterwards would clean them, do small repairs etc. and store it. The shop could either be physical and part of the basement, opening several times a week for a certain time. Or the employees could utilize the online-platform to present the furniture there, so tenants could see the stock online. They would reserve and buy it through the platform and only enter the basement to see the actual product and pick it up. In addition this could be coupled with events like dormitory flea-markets. Furniture of hygienic concerns, as anything with upholstery or textiles would probably still be disposed if it's not cleanable.

The funding should occur through several of the previously mentioned economic instruments. This solution is most likely to be implemented, as the investments and changes required would be relatively small.

6.3.4 DIK rents Furnished Rooms

In this scenario DIK would rent a certain amount of their rooms furnished, to tenants who request it.

This is preferred by at least half of the surveyed tenants and seems most suitable for people coming to and going abroad from DIK. A quite radical administrative instrument to support this could be the implementation of a law, which requires landlords to provide furniture for tenants, who come from abroad and intend to stay only for a short time.

This scenario would be a use-oriented PSS, since the tenants get access to the furniture for a certain time (Lewandowski 2016) and on the other hand it would be a product-oriented PSS, as service packages are necessary to maintain, repair and take back the furniture (Besch 2005). Therefore, this would require a cooperation of DIK with a company offering circular furniture and the respective services.

As this solution has to compete with cheap furniture (Besch 2005), it must provide a cost-advantage for tenants since their purchase decisions are mostly driven by price. Consequently it must be supported by various economic instruments becoming effective through an EPR, so value-maintaining practices and circular products become affordable.

Two scenarios are possible, either the rooms could be equipped with basic furniture, as provided by AUAO.

Or DIK could offer a certain variety of products to choose from, so the specific needs of the tenants on furniture are fulfilled. In the second version, this could be supported with the homepage, where future tenants could design their room online with a desired furniture-

package, which would be furnished as requested at the beginning of the rental period. The cooperating company would provide a certain stock of furniture that is stored at and used by DIK to furnish the rooms. Smaller repairs, maintenance, cleaning and changing of components would be performed by the inspectors at DIK. Remanufacturing, refurbishment, providing spare parts, bigger repairs and recycling would be performed by the company. A long-term cooperation seems necessary to avoid systemic obsolescence of this furniture system, e.g. by providing remanufacturable components.

Physical durability of the product is required so it can withstand careless treatment, which means a robust product architecture and surfaces that don't scratch easily or have permanent stains. The old shelving system shows that even products made from artificial wood can last long when maintained properly and the examples from Vitsoe (Bocken et al. 2016) or similar are proof that the lifetime of products is also strongly influenced by the manufacturers.
Design for cleaning and hygiene means a piece of furniture has cleanable surfaces and upholstered parts can be detached and washed easily, such as mattresses or any other furniture with textiles or upholstery. This service must guarantee the tenants to rent furniture that is not infected with bedbugs and can be supported by using furniture-equipment as mattress-protectors.
Design for modularity would enable to functionally and aesthetically adapt and upgrade the product to the individual user, like exchanging upholstery to the desired aesthetic or when it's used up (Bosch et al. 2017) or bed-frames that can adjust to the different size of the user. On the other hand, aesthetic durability or timeless design could fight aesthetic obsolescence long-term. Design for disassembly could enable necessary repairs by the inspectors and the company.
Design for stackability, foldablity or disassembly without compromising the durability of the furniture, can enable space-saving storage at DIK and efficient transport necessary for reverse logistics.
To summarize, this solution could be tested for a certain amount of rooms and duration, to evaluate the acceptance of users and its financially feasibility, which could be in cooperation with a CE furniture company like from the office sector.

6.3.5 DIK becomes a Circular Economy Village

This scenario builds upon the previous solution, except that it would also cover other products that are regularly disposed: bikes, clothes, textiles, household-items and electronics.
A combination of different previously discussed initiatives should keep products longer in use and ideally return materials to value maintaining recycling facilities. Products that are not in use anymore should be traded through the online platform or donated to the local second-hand shop. Improved cleaning services could allow to reuse textiles or upholstered furniture and clothing containers would enable reuse instead of disposal. A repair service or access to repair tools in the basement could extend the lifetime of various product groups, as well as workshops for repair and upcycling could be organized.
This could also be a cooperation with several companies and the municipality and needs to be supported by several instruments implementing a broad set of environmental legislation.

6.3.6 Summary of Solutions

The first idea, cardboard-furniture, would present a solution that would accept the linear end-of-life and short lifespan of products, thereby only reduce the emissions generated. This *end-of-the-pipe* solution (Unruh 2002) would not require any changes in the system's architecture, except the type of products consumed, which use and waste fewer resources, thereby narrow the loop.
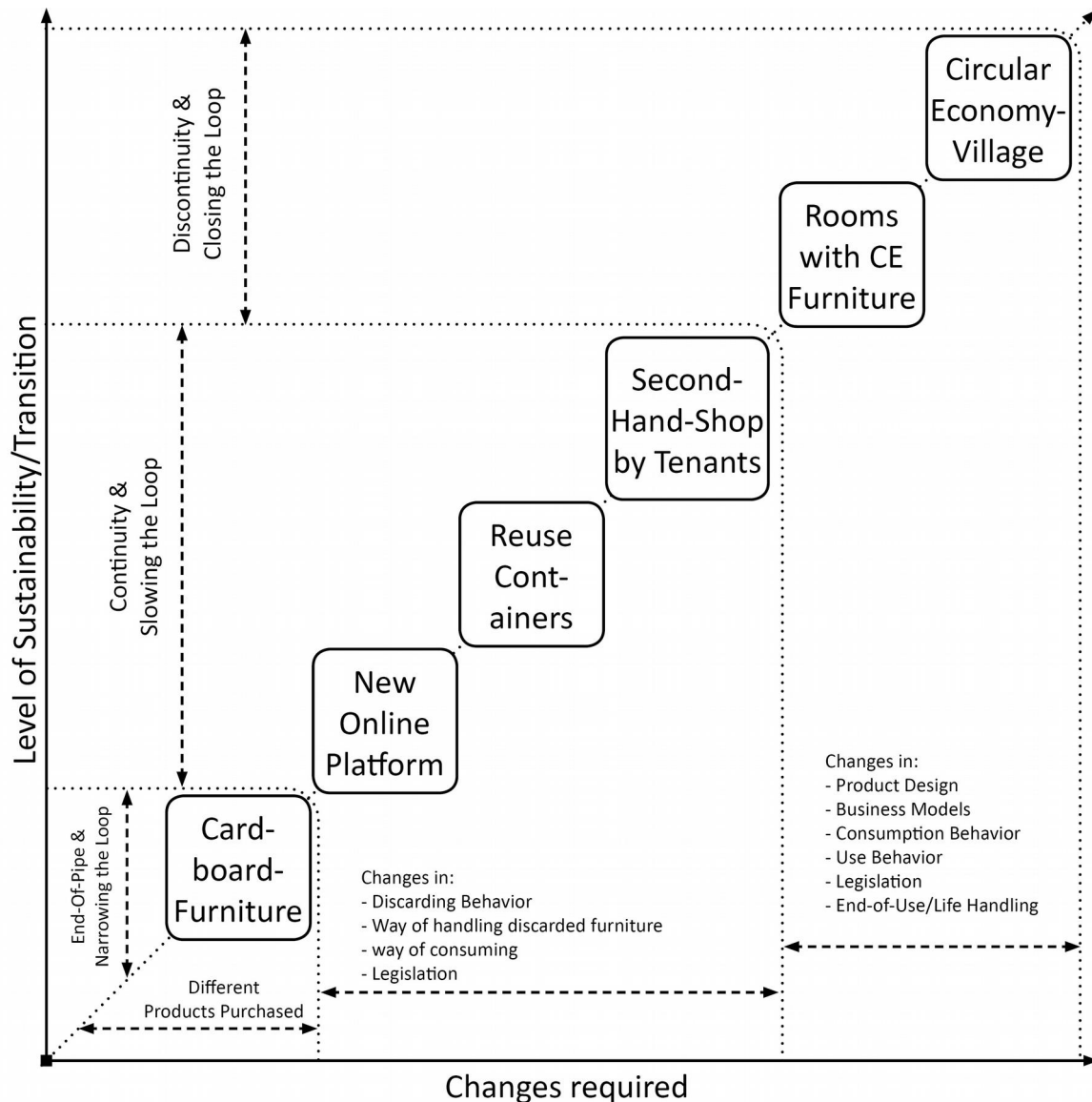
Figure 6.5: Iterative Solutions for Dormitory from Linear Consumption to Circular Use of Furniture (Graphic Created by Author)

Solutions 1-3 would not require a change in product-design, but are suggestions to keep the non-circular designed furniture longer in use to slow the loop. They require incremental changes in the system, like the infrastructure in the dorm, as well as different behavior and supportive legislation. But since the business-models, product-design and the end-of-life treatment would remain the same, the overall system architecture *continues* (Unruh 2002).

Solution 4 would require drastic changes in design and business-model of furniture-manufacturers, so the resources can run in closed loops. Besides, it would require

changes in consumption behavior from tenants and in the practices from disposal to value-maintaining activities by the inspectors, as well as several legislative changes. Changes in the local infrastructure should support reuse and product return, whereas the waste-management would be removed, presenting a *discontinuity* (Unruh 2002) of the system-architecture.

These solutions present iterative steps, building up on each other, that could enable a shift from linear consumption of furniture to a circular use at this dorm.

7. Conclusion and Implications

7.1 What needs to change so the furniture-sector becomes circular?

To answer the main RQ: '*What are the influential factors that make furniture become waste and how do they need to change to implement a circular solution in a Danish dormitory environment?*', the following aspects need to change to make the furniture sector more circular.

Firstly, the current state of not measuring furniture-waste (EEA 2018) and it's treatment needs to change, so the problem can be quantified and perceived by the public. A mandatory keeping of statistics by waste-managers for furniture (FPRCR 2015), that are accessible by the public, could change that.

The main purchase driver for furniture by all stakeholders was price, but environmental considerations have shown to be less influential (Edbring et al. 2016), therefore sustainable products need to be less expensive than unsustainable ones.
Fees for the end-of-life management according to the waste-hierarchy (FPRCR 2015), implemented through an EPR scheme, as already in place in France (Forrest et al. 2017), would reflect the full environmental damage of products to hold producers more responsible for costs that are currently covered by users and society.
The implementation of the Green Furniture Market (GFM) Labeling according to CE principles (Forrest et al. 2017) and a respective categorization and pricing would create product-prices in favor of sustainable furniture. Additionally importers should be covered here as well (Forrest et al. 2017), as their current advantage is reasoned by outsourcing to low labor-cost countries etc. (Renda et al. 2014), so the higher environmental impact from transportation could be balanced out with a transport fee.
I assume, higher product prices could also result in higher financial value to resell it, as the price difference between new and used furniture is yet not significant (Forrest et al. 2017). To avoid that only high income consumers can afford sustainable furniture, the consumer-price could be coupled to the level of income.

Value-maintaining practices are currently not taken up by stakeholders, as labor-costs exceed the prices of new products. Reducing the tax for labor, which is a renewable resource according to Stahel & Clift (2016), will set money and time free for these practices. The implementation of an EPR and the design of labor taxation in accordance with the waste-hierarchy (FPRCR 2015), that results in lower costs, the higher you operate in the hierarchy, would support these activities like for repair as in Sweden (Forrest et al. 2017) or for reuse as in Bulgaria (EEA 2018). The VAT directive allows EU member states to define this freely on goods and services (Forrest et al. 2017).

Change of practices by consumers during use are necessary as they have to adapt to the new CBM and become aware of the advantages it holds. Additionally, the end-of-use practices need to change, instead of disposing, actions should follow the principles of the waste-hierarchy or the CE by bringing it actively into reuse. Consumption decisions could be guided through better labeling such as the GFM approach (Forrest et al. 2017).

Changes in business-models for companies to make the transition from linear to circular, probably also requires direct financial support, like the CE fund in Scotland (Forrest et al. 2017). Because most of the companies are SMEs (Renda et al. 2014) and the products of furniture giants like IKEA were found to be disposable, support should be adapted to the size (FURN 360, 2018) and financial capacities of the enterprise. This should enable taking the product back and offering repair services, remanufacturing and recycling instead of downcycling, which requires cooperation and building a local network and infrastructure around this business (Nußholz 2017). The consumer sector could learn from the office sector, which has partly already established circular solutions (Penty 2020).

Product design and CBM are interdependent entities (Bakker et al. 2014), therefore furniture needs to be redesigned to enable central activities of these businesses. The design and materials need to change so the products stay longer in use (slow the loop) and can be remanufactured and recycled (close the loop). Specific criteria are design for cleaning and hygiene, durability and design for aesthetic and functional adaptation that enable reuse. Foldable, stackable and disassemble furniture (Hennessey & Papanek 2008) would allow manufacturers or commercial second-hand initiatives to transport and store furniture efficiently until they are reused, without compromising it's durability (Penty 2020). Materials and components should be designed for repair (Forrest et al. 2017), ideally by user themselves, and refurbishment. Design for disassembly enables to exchange and separate components when they break and improves its recyclability at the end-of-life (Bosch et al. 2017). Mixing and permanently attaching materials of the components should be avoided (Bärsch et al. 2001) to separate the materials and bring them into the respective recycling-stream.

The current reuse and repair infrastructure for furniture is weak, besides changes in labor taxation, they need to be supported directly, e.g. by subsidizing rents for businesses operating higher in the waste-hierarchy, so more second-hand shops can open up. Additionally storage rooms inside houses similar to the Møbler room, as described by ACA (App.13) and suggested by Fortuna et al. (2017), can enable local reuse.

End-of-life treatment needs to improve and should ideally handled by the manufacturer as part of the EPR. Separate material streams and a design that allows to separate materials, improved recycling technology and materials that can be recycled are necessary. Even though some of the HWRC act according to the waste-hierarchy, like AGS, reuse can be increased by letting reuse-organizations handle the collection of bulky-waste, as in England (Curran et al. 2010). Besides higher fees for the waste-treatment, a ban of incineration is thinkable as well, as the ban of landfill has shown to be an effective tool (FPRCR 2015).

Without the implementation of any mandatory political instruments, it is very unlikely that the current disposable character of furniture will change anytime soon.

7.2 Research-Limitations

One the biggest research limitations of the primary research was that the central stakeholders were not giving information, were not open for a cooperation and were not perceiving the issue of furniture-waste, specifically the waste-managers, the local municipality and the responsible housing organization, respectively.
The language barrier was noticed several times during the research, as it didn't allow to interview anybody who is not speaking English. This burden was sometimes overcome with people translating, but also could have been a reason why some interviews were not held. Therefore, a research team should always consist of at least one native speaker. The observations in the research environment were as thorough as possible, but shouldn't be considered complete, as this wasn't a seamless monitoring. A leasing service would have been contacted as well when more time would have been available.

Additionally available information on the size of the furniture industry in regards of circular activities as reuse and repair are limited, as well as those on the amount and treatment of waste. Other literature noticed missing were reports on the lifetime and durability of furniture, describing the current status, how long it could potentially last and how it developed over time. A study about pricing of furniture, e.g. it's historical development and which price level is the most consumed etc., would have been helpful as well. For the specific research content, furniture-waste in dormitories, no scientific articles were found. IKEA's position towards sustainability was partly read, but would have required an objective analysis of their products and is not included here due to the page-limit.

Practice Theory has been applied in this research field by Hebrok (2016) and Fuentes (2017), but was chosen to be not used due to a lack of expertise and time to get into this theory, but could be done if the topic is further researched.

Finally the limitation due to the page numbers challenges the amount of information to include, the level of detail to present and the breadth and depth of the analysis.
The influence of the shut-down due to the Corona-virus is described in the disclaimer.

7.3 Reflections on Experience – What could have been better?

Even though RQs were posed at the beginning of the thesis and were partly revisited, they became more background orientation than actual guidance, therefore the research was more lead by intuition than by clearly articulated goals.
Although the research was always following a clear planing and time-schedule, some fields in the literature review were too intensively covered, such as the CE framework at the beginning, so other topics were less intensely reviewed.

Working on your own also results in 'operational blindness', therefore probably several contextual mistakes were overlooked. Additionally the author assumes that this research was biased, due to the auto-ethnographic and non-local perspective.

7.4 Further Research

This case-study, furniture-waste in a dormitory environment, presented a glimpse in a presumably new field of scientific research. More importantly, the relation between short-term living and furniture-waste was indicated, which could be a contributor to furniture-waste in other areas as well. This should be further investigated, first more qualitatively and quantitatively in dormitories and secondly in similar fields as hostels, hospitals etc., where people only live for a short time for different reasons, but still need furniture.

Specific future RQs could be:
How does nomadic living, enabled through globalization, contribute to the issue of furniture-waste?
What is the relation between short-term living and furniture-waste?
How can the circular ideas from office sector for furniture be adapted to the consumer sector?

The drivers behind this mobile way of living can be manifold: "*Industry & Academe, the military and most importantly, changing life-styles among young people tend to make us all more nomadic.*" (Hennessey & Papanek 2008, 2), but this lifestyle should not go in hand with a wasteful living.

Developing solutions together should be striven for, but this requires first documenting the problem, which was done by this research, second acknowledging the problem, and third the willingness to solve the problem through cooperation. This includes the people using, maintaining, producing furniture and handling the waste, as well as local municipalities and sustainability experts.

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Appendices

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Appendix 1 – Stakeholder Contact Overview

Chart A1.1: Overview Stakeholder Contact

Stakeholder Name	Way of Contact (Date)	Outcome of Contact
Contact Person + Position		**Outcome protocol in Appendix**
Aalborg University Accommodation Office	Email (23/02/2020) Interview held (25/02/2020)	Interview held (25/02/2020)
Deborah Vliemans, Employee for handling furniture in subrented dorm rooms		Interview protocol/transcription see Appendix 4
Danmarks Internationale Kollegium (DIK) **Office**	Personal Contact (28/02/2020) Email (01/03/2020)	Interview held (10/03/2020)
Chresten Nielsen, Inspector at DIK	Interview (10/03/2020) More personal contact afterwards Refers to Vestforbrænding, Marius Pedersen A/S and KKIK for information.	Interview protocol/transcription see Appendix 5
Albertslund Genbrugsstation (AG) (Household Waste Recycling Center)	Personal Contact (07/02/2020) - gave contact information for municipality Interview 1 (05/03/2020) – incomplete, central questions not answered. He says he is not responsible for furniture and I should come back. Refers to Vestforbrænding for information. Interview 2 (12.03.2020) – Information given, Refers to Vestforbrænding for information.	Interview held – Part 1 (05/03/2020) Interview held – Part 2 (12.03.2020)
Employee Mirko, receiving donations for household-items and selling them Other female employee, sorting bulky waste at AG		Interview protocol/transcription see Appendix 14
Red-Cross-Store Albertslund (RCA)	Personal Contact and interview held (06/03/2020)	Interview held (06/03/2020)
Birte D.; volunteer working at RCA	Questions answered as good as possible, refers to Red-Cross Organization for more information.	Interview protocol/transcription see Appendix 15
Albertslund Municipality (AM)	Personal Contact with Information employee: rejected to give information Email to AM (23/02/2020): no response	No Interview Held Refers to Albertslund Agenda-Center for interview
Birte K. - Environmental Officer - Albertslund Municipality	Email to Birte K. (01/03/2020): responded, refused to give interview herself, refers to Albertslund Agenda-Center for interview	No protocol/transcription
Albertslund Agenda-Center (AAC)	Email (05/03/2020) Interview (12.03.2020) – also went to AG to continue interview (she translated Danish from the employee) Refers to Vestforbrænding for information.	Interview held (12.03.2020)
Signe Landon, Sustainability Consultant/Expert		Interview protocol/transcription see Appendix 13
Vestforbrænding (VB - Waste Managers for Alberstlund and in Denmark) handling furniture-waste at DIK	Email (23/03/2020; 29/03/2020; 06/04/2020): unanswered Phone (14/03/2020): first rejected to give information and referred to reports and other stakeholders as municipality. Confirmed to answer questions via. Email. Send the questions, stated to have no time.	Responded(14/03/2020), but questions unanswered/No Interview
Kenneth S., responsible employee for Albertslund and field of waste		Email reply see Appendix 16

	Second request to answer fewer questions or refer me to another employee (15/03/2020): unaswered	
Marius Pedersen A/S (Waste-mangers partly for furniture at DIK)	Email (14/04/2020) - general email): answered, said they can't give out information about customers .	Responded (14/03/2020), but questions not answered
Pia Buus, Environmental Consultant	Email (14/04/2020 – direct to employee): said they don't have DIK in the system and can't answer the questions	Email reply see Appendix 16
Remondis Danmark Holding Aps (Waste-managers for metal at DIK)	Two Emails (15 + 20/04/2020): both not responded to	No response, questions unanswered
Genera email		No protocol/transcription
Kollegiernes Kontor i København (KKIK Student Housing Organization Copenhagen Area) also responsible for DIK	Email (29/03/2020): responded, will answer questions Interview questions answered via Email (22/04/2020)	Interview questions answered via Email (22/04/2020)
Janne H.		Interview answers see Appendix 6
Centralindstillingsudvalget (CIU – Student Housing Organization Copenhagen Area)	Email (06/04/2020): responded(10/04/2020), most questions not answerable as lack of information, mentioned numbers of rooms they are responsible for in Copenhagen Area.	Responded (10/04/2020), 2/6 questions answered
Tom H. W., student Assistant		Email reply see Appendix 3
KBH-Kollegier (Student Housing Organization Copenhagen Area)	Email (06 + 19/04/2020) Response (21/04/2020): Can't answer any of the questions, exceeds their responsibility and knowledg.	Responded (21/04/2020), but all questions unanswered.
Employee Emil		Email reply see Appendix 3

Appendix 2 - Overview Student Housing Organizations Rooms

Chart A2.1 - Overview Student Housing Organizations Amount of Rooms/Houses

Housing Organization	Amount of Rooms / Accommodations	Furniture		
References	**Amount of Dormitories**	**Furnished**	**Unfurnished (explicitly mentioned)**	**Not explicitly mentioned**
Kollegiernes Kontor I København (KKIK)	**8108 rooms** (average per dorm ~ 270.25) **6556 apartments** (average per dorm ~ 218.5)	**32** (~0.4%)	**5097** (~62.7%)	**2979** (~36.9%)
see chart below (KKIK 2020)	**30**			
KBH Kollegier	**22 000 "Residents"**	Not answered, no information provided online or data sourced myself.		
(KBH 2020)	**180**			
Centralindstillingsudvalget CIU	**15 000 rooms**	Not answered, no information provided online or data sourced myself.		
Appendix 3	**Not answered/researched**			
Total Amount of Rooms: **45 100**				

Chart A2.2 - Overview Kollegiernes Kontor I København Amount of Rooms/Houses

Dorm	Location	Organization	Amount of Accommodations	Furniture		
			Subdivision with Rooms Total Amount of Rooms	**Furnished**	**Unfurnished** (explicitly mentioned)	**Not explicitly mentioned**
Albertslund Ungdomsboliger	Albertslund	KKIK	**1064**		**X** (all)	
			646 x 1 room; 99 x 1 room; 225 1.5 room; 93 x 2 room = **1268.5 rooms**			
Amagerbrogade 268	Copenhagen	KKIK	**90**			**X**
			36 x 2 room (f. max. 4 people) 54 x 1 room (f. max 2 people) = **126 rooms**			
Dahlerup Ungdomsboliger	Copenhagen	KKIK	**80**		**X** (all)	
			56 x 1 room; 24 x 2 room = **104 rooms**			
Danmarks Internationale Kollegium	Albertslund	KKIK	**448**	**X** (20)	**X** (492)	
			384 x 1 room; 64 x 2 rooms = **512 rooms** - ca. 20 subrented from AAU			
Det Nye Emdrupborg Kollegium	Copenhagen	KKIK	**111**		**X** (all)	
			108 x 1 room; 3 x 2 room = **114 rooms**			
Falkoner Kollegiet	Copenhagen	KKIK	**114**			**X**
			104 x 1 room; 10 x 2 room = **124 rooms**			
Flintholm II	Copenha	KKIK	**92**		**X** (all)	

Name	City		Rooms			
	gen		66 x 1 room; 26 x 2 room = **118 rooms**			
Flintholm kollegiet	Copenha gen	KKIK	**119** 119 x 1 room = **119 rooms**			X
Frankrigsga de Kollegiet	Copenha gen	KKIK	**126** 126 x 1 room = **126 rooms**		X (all)	
Grønjordsk ollegiet	Copenha gen	KKIK	**920** 840 x 1 room; 80 x 2 room = **1000 rooms** - option to rent furniture through Møbelbanken		X (all)	
Hedorfs Kollegium	Copenha gen	KKIK	**52** **52** x 1 room = **40 unfurnished rooms + 12 furnished rooms** (12 x furnished rooms are only for foreign students.)	X (12 x)	X (40)	
Holmbladsg ade 70C	Copenha gen	KKIK	**35** 31 x 1 room; 4 x 2 room = **39 rooms**			X
Husumvej 106	Brønshøj (Copenh agen Area)	KKIK	**3** 3 x 1 room = **3 rooms** Room with fridge/freezer and cupboard in the room, shared kitchen and shared bathroom. → not real furniture			X
Hvidovre Hospitals Kollegium	Hvidovre (Copenh agen Area)	KKIK	**296** 296 x 1 room = **296 rooms**		X (all)	
Kagsåkolleg iet	Søborg (Copenh agen Area)	KKIK	**307** 162 x 1 room; 49 x 2 room; 96 x 3 room = **548 rooms**		X (all)	
Kirsebærha ven	Valby (Copenh agen Area)	KKIK	**12** 12 x 1 room = **12 rooms**			X
Kollegiet Granbo	Brønshøj (Copenh agen Area)	KKIK	**79** 71 x 1 room; 8 x 2 room = **87 rooms**		X (all)	
Kollegiet Sofiegården	Copenha gen	KKIK	**156** 91 x 1 room; 55 x 2 room; 10 x 3 room = **231 rooms**		X (all)	
Kvintus Kollegiet	Copenha gen	KKIK	**118** 101 x 1 room; 17 x 2 rooms = **135 rooms**		X (all)	
Murergårde n	Copenha gen	KKIK	**2** 2 x 2 room = **4 rooms**			X
Rebæk Søpark	Hvidovre (Copenh	KKIK	**361** 361 x 1 room = **361 rooms**		X (all)	

Kollegiet	agen Area)					
Rigshospitalets Kollegium	Copenhagen	KKIK	**414** 414 x 1 room = **414 rooms**			**X**
Robert Jacobsen Kollegiet	Copenhagen	KKIK	**120** 120 x 1 room = **120 rooms**		**X** (all)	
Ryesgade 58-58A	Copenhagen	KKIK	**12** 12 x 1 room = **12 rooms**			**X**
Sadolin Kollegiet	Copenhagen	KKIK	**57** 57 x 1 room = **57 rooms**		**X** (all)	
<u>Solbakken</u> ("family /green dorm")	Copenhagen	KKIK	**140** 140 x 2 room = **280 rooms**			**X**
Stærevej	Copenhagen	KKIK	**80** 55 x 1 room; 25 x 2 room = **105 rooms**			**X**
Sømoseparken	Ballerup (Copenhagen Area)	KKIK	**100** 100 x 1 room = **100 rooms**			**X**
Øens Kollegium	Copenhagen	KKIK	**24** 24 x 1 room = **24 rooms**			**X**
Øresundskollegiet	Copenhagen	KKIK	**1024** 527 x 1 room; 401 x 2 room; 96 x 3 rooms = **1617 rooms**			**X**
Total KKIK						
30 dorms	Copenhagen Area	KKIK	**6556 apartments** (average ~ 218.5)	Total rooms (%)	Total rooms (%)	Total rooms (%)
			8108 rooms (average ~ 270.25)	**32** (~0.4%)	**5097** (~62.7%)	**2979** (~36.9%)

References:

(KKIK 2020)
Kollegiernes Kontor I København (KKIK); Overview Housings; 2020;
https://www.kollegierneskontor.dk/default.aspx?
func=kkikportal.kollegiumlist&mid=40&topmenuid=34&lang=GB (accessed 01.04.2020 12:00)

(KBH 2020)
KBH Kollegier; Homepage; 2020 **https://kbh-kollegier.dk/** (accessed 27.04.2020 12:00)

Appendix 3 - Correspondence Student Housing Organizations

<u>Questions to Student Housing Organizations (SHO):</u>

Dear Ladies and Gentlemen,

my name is Tobias Hauptmann and I am writing you as I am in need of information from you for my Master Thesis research of Sustainable Design (MSC. Eng.) at Aalborg University.
The thesis is titled "Furniture Waste in Dormitory Environments", for which I research this topic in general and by means of a case-study Danmarks Internationale Kollegium (DIK) in Albertslund.
Furthermore I would like to know how strong this issue is in other dorms or student housing organizations. As I don't have the capacities to investigate this case by case, I have some questions to you to complete my research.

It would be great if you find the time to answer them. If you are not allowed to do so due to confidentiality or don't have the capacities at the moment, please say so.

1. What is the total number of rooms you rent?
2. What is the number of rooms you rent in Copenhagen/Greater Copenhagen?
3. How many of these rooms are rented unfurnished?
4. Do you know if furniture-waste is a problem at the dorms you rent out?
5. How much furniture-waste occurs in your dorms? (for example tons of waste per year)
6. What are the measurements you initiated/follow to prevent furniture-waste?
(for example option to rent furniutre/Mobler Bank; storage-options of used furniture; self-organized second-hand shop; reuse platform; inhouse repair-service etc.)

I am looking forward for a response.
Kind regards and stay healthy.

Tobias Hauptmann
Research Student Aalborg University
Sustainable Design Msc. Eng.

<u>Answer Centralindstillingsudvalget CIU (10/04/2020)</u>

Dear Tobias.
Unfortunately I can not help you very much. I can tell you that the total number of rooms in our system is about 15000. The reason that I can not give a more accurate number is that there are a number of deleted rooms which will still appear on our end, even though they do not exist (often they will have been duplicates on other existing housing and kept due to archival practices) and other such inaccuracies.
I would estimate that by far most of our housing is in greater Copenhagen, if I had to guess I would say that less than 10% is outside it.

As CIU is only an approbation committee we are not involved with the daily administration of the dormitories and housing, and as such I would advice you to ask the individual housing company to get answers on question 3-6.

I wish you the best of luck with your thesis

Med venlig hilsen

Tom H. W.
Studentermedhjælper
CIU

Answer Kbh-Kollegier (KBH) (10/04/2020)

Hi Tobias

Unfortunately, we do not handle any of the apartments, but only facilitate information about the housing market in Copenhagen for students. I would suggest that you reach out to the big facilitators in the industry.

Good lock on your Master's.

Best,
Emil
Kbh-Kollegier.dk

Appendix 4 - Interview AUAO - Summarizing Key-Statements

Interviewer: Tobias
Interviewee: Deborah Vlaeymans
Date: 25/02/2020
Time: ca. 12:30-13:45
Place: Aalborg University, Copenhagen Campus

As the interview recording was malfunctioning, the record stopped after 15 mins. The interview was transcribed with a transcription program, which also worked flawed. Therefore based on the given transcription, handmade notes and memory protocol, the content was corrected by the author.
The interviewee read the transcription of the summarizing statement and gave her consent to use it.

<u>Interviewee Description:</u>

Deborah Vlaeymans is employed at Aalborg University's section Accommodation Office. She organizes everything that is about the living for international students mainly with the focus on the rooms the university is subrenting in the student dorm Danmarks Internationale Kollegium (DIK) in Alberstlund. This encompasses communication with students, inspectors at the dorm, with employees of the housing organization Kollegiernes Kontor i København (KKIK), handling the take-over of the rooms at the beginning and end of each rental period, as well as delegating the maintenance, repair, transport and storing and purchase of the furniture, as well as the cleaning of the rooms.

Selected Key-Statements:

Deborah:
In Denmark, the trash area like when you live in a big block, you'll often have these reusable rooms now, where you can put stuff that still is good like a pan or a pot and then other people can take it but it's of course covered.

Deborah:
But for the beds it's really a problem. [...] the main issue the beds if somebody could find tidy, how you solve this because there is the hygienic thing with it.

Tobias:
Why do you offer furnished rooms?

Deborah:
We offer 19 rooms to International students newly arriving to our University.
[…] Now, we have only the rooms at DIK left. We also previously had rooms at Tingbjerg Kollegium but they are being shut down. We can have them in Albertslund because this is another municipality.
[...] We cannot just subrent college rooms there. [...] we cannot get rooms in Copenhagen municipality because this the municipality has very strict rules. Everything goes through KKIK or CIU. They are the central offices to divide dorm rooms to all students of all universities in Copenhagen.
[...]
This is how it is organized. Yeah sad for us. There's nothing to do about it how it is right now. We we are happy we have this room.

So we can offer some possibilities for international students who come to Denmark don't speak the language, don't have Network, [...] Like when you come to Denmark, you have to get CPR number, CPR number you can only get if you have an official address. Yes. So, all those Universities offer these rooms, with furniture because of course an international students will not be flying over with a bed or table. And if it's an exchange student, who is here for 6 months it doesn't make sense that he or she has to buy it. So it's an extra service.
But of course we charge this service because we are nonprofit service at our campus. We don't of course gain money with it and but we cannot afford losing money. It has to go in zero just so to buy new furniture every year or like what when we have to replace old foreign or broken furniture. [...]
It's like a fee every month, it's hundred and fifty Krones right now the students pay so we can make sure there is money to buy new furniture. There is a 300 service fee in total and 150 is for the furniture then there is 75 for maintenance service and the rest is inspector. [...]
We are nonprofit, it has to just run around. It's not we have we do not want to take more money than is necessary. But then of course we have to have strict rules and if something out of the usual happens, we have to charge fees.
[...]
This is because we have we are dealing with International students coming in with flights or trains or whatever and having no Furnitures as a service to help them know getting settled in Copenhagen.

[...]

Tobias:
How much work is related to organize that the rooms are furnished?

Deborah:
We have a storage room in our basement here where we keep furniture. There are some new beds stored from Tingbjerg, this other dorm that we had to give up. It was not possible to stay there anymore for Aalborg University. The beds that I valued were still in a good conditions and were put in the basement. So now I think there are 8 beds right now in storage.
But I think it's still good if there were no bedbugs reported or anything. So if it works it's fine. So then when we get new rooms, yes, we have some move officers with me and then of course putting it inside the room when the students move out.
I do the inspection and then I make a list what does is necessary to replace and what looks still good.

[...]

Tobias:
Okay, so when something is broken you throw it out?

Deborah:
Yeah, if it's really broke, unless it's a leg from the bed then I sent, when I had this issue, [...] a repair service to fix the leg, instead of just throwing out. I keep also the legs, if a bed is used and has to go out, I take the legs off.

Tobias:
Yeah, you actually do that?

Deborah:
I do that but I just that is because I'm a bit unusual.

Tobias:
Because of your personal motivation?

Deborah:
Yes, my personal motivation.

Tobias
And that's really what makes the difference just is these things you take off. No, that's absolutely adorable because that's one way how to avoid waste, to store even the spare parts and repair stuff. That's really great. Yeah, but it should be not a personal initiative but rather a structural initiative.

Deborah:
As I think because we are so small at Aalborg University, it is connected to what sort of person you are: 'What are your things you value high?' But bigger universities like DTU that have like I don't know, many many rooms, it has to be effective. Yeah, so I don't know if you have time, so maybe you can ask them as well.
Yeah, maybe you could put it in as a policy ways, that the legs have to be reused. Yeah, it could also save money because I don't have to buy a new legs. But it's always on different levels of entities.

That is also in the costs for maintenance service. Also the moving officers need to be paid, this is quite expensive. They have a truck and they have to come at least four times a year.

Tobias:
Okay, so but like I said, I think since this is not a high amount. I think that would be good to just adapt it, that's no cost. I thinks 300 Kronas extra per month is really not a big deal.

Deborah:
No, I think if you're like there for 10 months, it's three thousand Cronas. That's now the result, so you can already buy some stuff off that.

[...]

Tobias:
So just to make clear, what pieces of furniture are in the room?

Deborah:
So we have a bed with a mattress cover protector on top of it.
We have a table, a chair, a table lamp, a wastebasket and the blinds for the window.

Tobias:
So the shower curtain is also waste?

Deborah:
Yeah, that is really annoying me, but it's true, we renew it with every student. […]
If you leave it clean then I will reuse it because I want to reuse of course. I check if its

newly bought and what was of good quality, then I will leave it. […] But the shower curtains, that's a difficult one because you can wash it, yes, but then who will do that?

Tobias:
I did it for my one. You don't remember, but when I moved out, I washed the one from me. [...]

Tobias:
How often is the Furniture Exchanged?

Deborah:
How often is the furniture exchanged? That is totally depending on if it's broken, or ugly or hygienic reasons, then it needs to be replaced.
But the shower curtain is exchanged with every new student. Unless it's good quality because there has been some different qualities that have bought for the dorm and if it's good quality and it's fine, then I leave it, but otherwise it's standard to change it.
And for the rest it's decided on the inspection.

[...]

Tobias:
How do you define or decide which items are in the room in regard of living needs?

Deborah:
It's totally basic stuff bed chair table.
But we also had shelves, actually this one looks really like the one we had [pointing to a photo of a shelve]. *Also it fastly gets trashed, or gets ugly coffee stains, something sticky. We cannot leave it like that for a new student arriving and then we have to throw it out and then it will increase the costs and also we create more trash.*
So that's why it's so basic.
Actually it was my idea to have wastebaskets. I don't know if you had one, a black one. And now I'm a bit like 'mmmm', maybe because they get quite ugly inside. People have to use it, but people don't clean it. So then it's thrown out or I have to ask the cleaner to clean it up, but then it will cost extra.
But you do not want to put so many demands to the students.
There is already this issue with the toilet, the water is very high in calcium. Some of the toilets are totally ruined. You have to use these cleaning products for toilets, almost every other day because the toilets are so old and we will need to buy two new toilets.

[...]

Tobias:
From which store is the furniture bought? Why this store?
Let me guess, it's IKEA?

Deborah:
It's IKEA yes, but also, this is again my personal motivation, I have put some time into finding mattress protectors that are environmentally friendly.
I found one shop and then there is this stupid thing. I cannot buy there because they cannot send an invoice through the public invoicing system.
But otherwise, it's IKEA and also, if you know this place: Jysk Sengetøjslager.

But when I buy I always try to see if there is this flower from the EU.
I buy there because they can do this numbering for the public sector, but they also have
this labeling of the a flower, but a really ridiculously low level. But I think it's better than not
having it. And that's again just a personal motivation.

Tobias
So you decided and do the research?

Deborah:
Yes, and then of course price and quality.

So wait a minute because the tables are actually from the University, the facility
management keeps them for me. Also the old chairs they are kept for me even though
they are not comfortable.

But the lamps and the beds and the mattress protectors and the shower curtain are from
Ikea. Just the window blinds, they are from Jysk.
[...]

Tobias:
What are the most influential characteristics of furniture when you purchase them?

Deborah:
I guess yeah functionality is not really an issue, it's like what fits on the bed on the
measurements.
Aesthetic is not an issue, no. Although when I choose shower curtains and they are in the
same price, then I choose the one that maybe looks happier. Repairability?, no.

Tobias:
I mean, you mentioned it before, I guess you are concerned about repair?

Deborah:
I'm concerned but there is not really something I can do.
But I look for quality. But then price and quality is of course important.
Sometimes I can find something that is expensive and better quality and when they have it
in a reduction promo, then I buy it, like I did this for some mattress protector.

Tobias
So you have a certain budget and of course then you gotta try to get it as cheap as
possible?

Deborah:
Yeah.

Tobias
Okay. Repairability, it's not a concern because it's not really part of the design and it's not
really expressed.

Deborah:
No, hygiene this is also not really an issue. I mean What are what do you mean with it?

Tobias

Well, before you said it's an issue that you have to clean all the stuff that it's not sticky anymore, so that's functionality, so it's easy to clean. Because you mentioned also that people don't clean the stuff even though it would be cleanable with the baskets.

Deborah:
So in a way it (hygiene) is an issue even if it's not something you think about when you buy it, I guess. But for the others, it is very important to note that environmentally friendliness. If I could find mattress covers made from reusable materials or anything like that, then I would definitely buy that, but again out of a personal motivation.
I think the campus director would agree because as a campus we focus on sustainability. So I think he would not say no, so you don't you have to buy this cheap crap.

Tobias:
What happens to a piece of furniture when it's broken/not usable anymore? - Do you repair/let it repair or is is exchanged? When it's really broken your throw it out?

Deborah:
Yes. Or stains on the mattress that are there, too.

[...]

Tobias:
Do you dispose the furniture at DIK or do you bring it here?

Deborah:
That's the facility management who takes care of it. We are not allowed to put it there because it is too much.

Appendix 5 - Interviews Inspectors DIK and Notes from Tour through Dorm

First short talk before real interview (28-02-2020 – based on memory protocol):
> mentioned the problem of bedbugs (hygienic concerns) as part of furniture being thrown-out, instead of stored
> one inspector also tries to describe the problem with IKEA furniture, that the artificial wood-boards (OBS) are getting soaked with water (or similar) when being outside and therefore becoming quickly unusable

Brief conversation about the interview request (05/03/2020 – based on memory protocol)
When I asked them what will happen to the piano that was standing around at some bicycle stands the inspectors said to me, that the piano will be thrown away and they haven't done it yet because it's so heavy.
The furniture is handled: "*Clean and Silent*" as Chresten explained it

Interview with Inspector of DIK:
10/03/2020 - 12:00
Duration of interview and tour through the dorm: ca. 100 mins
Location: Inspector's Office at DIK in Albertslund, Denmark
Consent was given to use his name and the data he provided verbally. (03/05/2020)

Interviewee: Chresten Nielsen
Inspector at DIK, various tasks at the dorm ranging from maintenance of rooms, waste-handling at the facility (emptying waste-bins to waste-containers), etc.
The interviewee isn't very well spoken in English and had often strong problems to express his thoughts. Some of the interview parts were completed based on similar verbal expressions.

The interview was recorded via. phone and transcribed manually.

     Interviewer: Tobias
interviewee: Chresten

Interview Transcription

1) How many rooms at DIK are rented unfurnished?

All of them. [note: except the ones subrented from Aalborg University] *DTU (Denmark Technical University) were subrenting furnished rooms as well, like Aalborg University. When they gave up on them, they threw out all the furniture. In standard they are rented unfurnished.*

2) Why are the rooms rented unfurnished?

I think it's about money. It's a money questions, because if you want to have a new bed, if you come here, it will cost a lot of money. Because of the bedbugs and everything, that's a big issue.

So it would be a new bed with every new student?

Yeah. If you would have a bed with an iron frame, and you would have only the mattress, that wouldn't get cheap.

KKIK never considered renting out furnished rooms?

No, no. With such a system, I think, it would be very expensive to live here. It's mostly money and work related.

3) How long do people live here in average?

The problem with this college (dormitory) here is, that most of the people here all want to live in Copenhagen and they use this as the first opportunity to move into Copenhagen later.
I guess it's half year.
I've read that most of the young people have money problems, because they take a loan. The costs of moving, it costs a lot of money every time you move. But if you would move here, and would say: it's the greatest place in the whole world and would stay here for five years, the whole study, it would be cheaper, for the costs of the painting and renovation of the room.
I hope they will live here longer, but I think it's one year or half a year. But if they would live here the whole student time, that would be the best thing.
I see it (the short duration of tenants living at DIK) as a problem, because if they choose to live here, like for the next six years, and if you would get a bed, for like 1000 Kronas, it would be ok to dispose it, but after only six months it's a problem to dispose it. (financially) It's also an economic problem. When you move in, you pay a deposit and this deposit I will then use again to paint the room, but if you live here for six years, I should pay it all (the costs for the painting), as you paid your rent and everything and I earned some money for this.
I have also lots of rooms, which are not rented out.

Do you know the number of rooms which are not rented out?

No, I will ask Janne from KKIK.

I guess this problem could also be a problem at other dorms.

Yes. We are the smallest in this field. There are lots of other dorms. We are one of the small fishes.

4) How many people are moving in and out per month?

About 20 people.

5) How often are the items that are already in the apartments/rooms exchanged? (blinds, shower curtains, toilet seats, wood strips)

The blinds, I will change every time, if you smoke in your room, they get yellow and you're not good in cleaning, like that they are dusty and most of the time, they are broken or bended.

So you don't clean or repair them, you just remove them?

Yeah, every time, ah, not every time, but most of the time, one out of ten is not thrown out.

Would you repair it, if you have more time or more staff, like the design would be made for repair?

No, it's not a design fault. I think it's the easier way, because you can melt them, how do you call it, recycling. I will tear it down and put it into the iron container (metal waste-bin). A new one cost 160 Danish Crones, it's very cheap, we buy them at JYSK.
And with the shower curtains it's the same. I could take down to the laundry and wash it with chemicals. But my time to do that is the highest price for that.

The problem is that buying it new is cheaper than work time in Denmark.

Yes, that's problem. We are also thinking to get some curtains, instead of the blinds. So you could take them down and wash them. But, again, there is someone who has to do the laundry. Fire-safety, yeah, maybe, but that they can't burn, like burn in a certain room-temperature (self-inflame).
With the toilet seat, it's the same, but we don't exchange that often. Yes, it's all thrown out when it's broken, but we sort the plastic when we throw it out, so it could get into the circle again, I hope.
I think, with plastic, we might send it to Germany.

Why are so many blinds thrown-out?

When they are broken or dirty from smoke or dusty, I throw them out.

But wouldn't do it, if they are cleaned by the students?

No, if they are fine and the cord is good, it will stay. There are a lots of things with them, it should be nice and clean to look at them. The blinds, I hate them. I would never have them in my room. I would prefer to have curtains in my own room.

6) What happened to the previous shelving system for the rooms? - Can you show me some shelves, if they are still in the basement?

We threw them all out, it was an old system and it was not fine.

How long do you work here?

Since three years. The system is from the beginning (dormitory was build in 1972). And if you look at the closet, the shelves would look the same.
It's easier to go out to IKEA and buy some new stuff. You can get it in white, yellow, black, you can get it what you want to have around you.
I think this shelving system was quite old-fashioned. Like if you have a young girl, she would ask, why should I look at some old stuff like that.
I can buy new stuff for a few hundred crones in IKEA and again it's the price-problem.

7) How often are the furniture in the common areas exchanged?
[note: There has been new kitchen furniture recently]

I think the tables from before were from the eighties.

I think it would have been repairable, since I saw them.

Yeah, but again it's the price-problem (salary for labour). The new table costed only 1200 Crones, and I think it was 1500 crones with chairs (6), that's cheap.
But you can still see the stand (table legs/frame) outside, to get a new board plus my time to do it, that's again too expensive. It's always work and time and price.

Did you buy new kitchen furniture because it was broken or because this is done on a predefined pace (e.g. after xx years)?

We have a problem here in our college (dorm), because we have a boarder-committee, Mathias and Sarah. Everybody that lives here pays rent and some of it goes to the social work and to buy some social things. So the study-board can say: We want a new table or a new microwave and that's how it works with that part.
When I started here, there has never been a study-board, now we have it since the last two years. And they decide how the money is invested in.
If I have (manage) the money, the inspector, it would be my standards and now it's their standards and decisions. If it would be on my side, I would rent it like a hotel, that's the standard here: bumbumbum.
But again, if we would to choose to have furniture in the room, to the standard I would have set..

But you would have rather furnished the rooms than the common areas?

Yeah,I think so.
But there is another problem. There is two study-boards, one with the money and the younger ones. I am employed by them and the younger ones are my employees, I am in the middle between them.
The study-board from the tenants, Sarah and Mathias, everybody can join, they decide what the money is used for.
But the other board, there is nobody who owns it. It means they own themselves, you pay the rent to live here and they pay the tax and everything. So we give this place a cheap rent. The Kommune looks at the money and they look at this place here, if it fits all standards.
It would be easier, if it would be a hotel here, with the higher standards, but his would cost again a lot of money.
But the whole concept with kommune and the dorm, is that the young can buy (rent) cheap.

What happened to kitchen furniture after the renovation? - it seems that it was mostly thrown-out

We threw it out.

8) How do you handle private furniture of the tenants that is standing around inside the blocks, that is not furniture from the common areas? - do you dispose it when it's standing there too long?

Once a month, we go through the blocks and throw them out because of the fire-regulations.

Without these regulations, you would leave it there?

Yeah, maybe, if it's in good shape. But we also have the problem with bed-bugs, therefore I throw that out, because I don't know who it has.

But that mainly concerns beds and mattresses or also shelves and other items?

No, shelves, we could use again. Beds and mattresses, I will throw out, or sofas.

9) What do you do with furniture that is still usable and standing outside of the blocks resp. at the waste-bins?

We throw it into the container and so they come out to the regulation (?) and separate the garbage, what can burn (incinerated) and what can be recycled like iron (metal).

But no matter how it looks, you throw it out? Because you mentioned silent and clean as your strategy to handle furniture-waste.

Yeah, yeah.

10) Do you have any numbers on furniture waste that is created at DIK?
(for example numbers of containers, kgs of waste that is picked up by waste-manager)

We had the container emptied one time. I don't know the exact number of tons we throw out. But you can get a picture if you see it.

But do you know how often the container is emptied per year?

Yeah, maybe three or four times a year for the furniture.

What about the other waste?

It's every 14 days. The garbage can burn, we throw it out on Vestforbraending.

What about the waste-corner, where all the mattresses are?

Oh, yeah. People outside of the dorm, throw their garbage in there, some companies come and throw their shit there.
I should have a call from Marius [Marius Pedersen A/S], where he will take the stuff out with a container, which costs like 1000 Danish crones for 1 ton of garbage. I think it would cost ca. 2000 DKK to throw the stuff out there (from the small waste-corner). DIK should pay for this, it's a problem.
With the beds, it should only be iron [metal] in that corner. But because of my work regulations I will not get inside that place, since there could be a nail, that could hurt me. There will be a tool that grabs it, put it into a container and all will be driven to the recycling facility, where they burn most of it and can take the iron from it.
This is done by Marius (Marius Pedersen A/S). They take all stuff.

They collect all your stuff?

Yeah. All the furniture will be crushed, so the wood will go into one section and the iron into another of their system.

It's not Vesterverbraendig?

No. The stuff that burns will they (Marius Pedersen A/S) send to Vesterverbraendig and the iron to Frederiksberg and melt it to new conserves and cars and everything.
Here in Denmark, most of the stuff will get burned. What can provide heat, will go there.
We burn all our waste.

11) What kind of furniture do you see mostly disposed from the rooms?

Beds. And also tables, because it's so cheap.

12) When do you notice the most furniture being put out (season, time in the month) from the students? - e.g. in summer?

Here, in the springtime, when you move out, when the students will go home to their home-countries, like May or June. [at the end of the study period]

13) How much of the furniture put in front of the buildings would you say is still in condition for direct reuse or needs minor cleaning or repair?

With the beds I am not so sure it they can be reused. But the tables could definitely be reused. And chairs. But not beds, because of the bedbugs. I think most of the stuff looks not in good shape.
I hate IKEA, I bought my IKEA in 1983, I bought only Danish brands and it's very expensive to change if you move. When I buy my furniture, I buy it for my life.

But still even Danish product are disposed or destroyed, like a chair in our block or the piano Made in Denmark. Apart from that people are also disposing a lot of household-items and clothes. This should rather go to the Red-Cross Store.

Yes. It could be a good thing here. Because if you move home, you will not take your clothes with you. And if we have a container from Red-cross, that could work for them to collect it.

14) What happens with the furniture in the two waste-corners?

I think, none of them would be recycled. I think the wood, they would burn and the iron (metal) would be heated (melted). But it will go out to Marius, and he will sort it for both containers, for plastic and everything. He has the same waste-fractions we have here.

15) Who is picking up your waste/waste-manager in regards to furniture? / Who are the waste-managers?

It is Marius Pedersen A/S.
[note: later revisited this information that Vestforbraending takes care of the furniture-waste handling.]

16) What happens to the furniture afterwards? (resold, recycled, landfilled, burned?)

They go for heating the radiator. And for Gips (plaster) production, for which Denmark is the cheapest producer in the world. Only 5% of toxic fume can't be filtered out from burning.

    17) How much does it cost to handle the furniture-waste?

I don't know. Maybe Casper knows.

    18) What do you see as the biggest challenges to implement a re-use system for furniture (common or in individual apartments) here at DIK?

The price, it's too expensive (for repair and cleaning of the furniture). The table is good stuff to clean, the old furniture, you can not clean it (good enough), they are not smooth surfaces. Otherwise it would be very fast dirty.

    How about storage space, which I guess is limited?

Yes, but again there would be people required to take care of that job. Like posting it on Facebook. It then has to be a volunteer job.
But we have the space for it [to store furniture].

    A solution could also be a small business lead by the tenants, where they buy and resell the furniture.

We have the space for it.

    19) Would it be possible to develop a solution within the existing buildings to store furniture temporarily?

Yes. But I have not the time to do that. Someone who burns for this should do that. Yes, it could be a micro-business.
Again, we have also a lot of bikes. When people come here with their bikes but don't take them with it when going home. In the springtime, when I started, we collected about 100 bikes, which were collected by some guy. Normally it's maybe 64.
A new bike in Denmark would cost you 6000 crones. You should just repair it to reuse it again.

    20) Would you be open to for a solution that allows a less wasteful furnishing system?

Yeah, definitely.

Tour through the Dormitory (after the interview)

    How much does it to cost to handle the furniture-waste?

We pay that with our taxes, so we can't say it in detail Try to contact Jenne with that.
As well as for the waste-numbers, maybe she knows and also she is responsible. She can tell you how much many it costs.

[At waste-bins]

All this here, it get's burned. If we would be better to separate.

[At the waste-corner]

What you can see here is that they put every kind of stuff inside, but it should only be iron. I think it's about 2 tons, I will take a grab and take it out.

[Inside the fenced corner at the furniture container]

Here we have the furniture-container.

      So all of the furniture should come here and not into the other corner?

Yes. It would be easier if it would be put here, but we can't have it open.

      And this stuff is picked up by Marius (A/S)?

Yes.
[note: later revisited this information that Vestforbraending takes care of the furniture-waste handling.]

This container is for the normal household waste, which is emptied every 14 days and goes to Vestforbraending for incineration.

      With the furniture container, you just called them and they come by to pick it up?

Yes. And then they come, take it out, bring it to their facility and then come back with the container.
Maybe there is some iron on the big tables. And that's collect iron and wood, because we cannot put it there (the small waste-corner). And you can see the mattresses and how much iron is in there, it would have no meaning to burn it off. Because when they burn it there is a lot of iron in it.

      I was thinking about containers like this or shipping containers as a solution for storing furniture.

Yes. They have it like this at Genbrugsstation.

      Yes, but people will not go to Genbrugsstation.

No, they don't have any cars

      [going into the basement of the dorm] How many of these rooms do you have?

I think about eight, yes eight, one for each block (double block)

Here you can the problem. We have all that stuff from IKEA here. Things for the kitchen for 40 000 Danish Crones [ca. 5350€], it's cheap, we bought it reduced. That's the main problem, because it's so cheap.

And that's furniture from someone who ran from the bills. I have it here since a few months and soon I will throw it out.

Everything?

Yes, look at the shelve. Think about how much it would cost to paint it.

But with these bathroom shelves, you actually repair it?

Yeah. We didn't change it yet, but we keep them until we take the others down.
Also these old lamp shades (from the original furnishing system), I put them into the
dishwasher and make them clean.
With the shelves, if you would paint them white, they still could be used again.

Notes from the Tour:
> the small waste-corner is thought to be used only for metal parts
> this is not written anywhere and appears to be used for all kind of bulky-waste: beds, mattresses, a fridge
> during the observations it didn't seem that it was only tenants or people from somewhere else were disposing their stuff there, but rather also stuff that was placed before in front of the bins like beds etc. put into this fenced area

> shows the furniture container which is closed from all sides (with "roof")
> size: 2.05x2.20x6.0m = 27m³ – tampered shape ~25m³
> there is only two mattresses and one sofa inside, which have been documented between 03-05/03/2020, consequently it has been emptied recently, e.g. at the beginning of march
> so this type of container could be a solution to store furniture without being exposed to rain or harming fire-regulations
> this containers, in contrast, is not accessible for the students, as the it is inside the "waste-corner", which has a fence for which the tenants don't have a key to open and the container itself is also locked

> next to that container was an open containers with different types of wood boards, like old doors, table-boards or an IKEA shelve for CDs
> the inspector said it's going to Vestforbraending for incineration
> they try to separate as good as possible, but this is only limited possible

> Shows an almost empty room, only a few old kitchen-tables stored there.
> size: ca. 15m deep, 5 m wide, 2.5-3m ceiling height

> in front of another room, there is written "Møbeldepot Furniture Room" on it
> this clearly shows that there was not only a system in place for the furniture, but also space to store it in the very beginning

> showing more rooms and new delivered equipment for the common kitchens (plates, glasses, pans and much more) worth 40000 DKK, which is exclusively IKEA
> the main-factor for purchases is (short-term) price for when buying new, not how long-lasting it is and how that would affect long-term costs
> as also criticized by the inspector, that it's all very cheap (couldn't elaborate on that one, like many times before)

> another example is a tenant, who hasn't paid rent for two or three years and then just moved home
> this person left several pieces of furniture, which are temporarily stored in the basement,

but will be thrown-out soon
> he explained that the labor costs to make the furniture reusable would cost too much
> but privately, he sanded a table from him to refurbish it

> shows a room, where equipment for repairing is stored
> it also shows some items they are repairing
> like the shelves in the bathroom, where some surplus models are repainted until they are needed
> so storage, maintenance, repair and refurbish are practices done by the inspectors
> if it would be financially feasible, it would be done more

> tour shows that there is plenty of storage space inside the basement

> shows some minor left-overs of the old shelving system
> used for some storage
> mention it will or was all thrown-out
> we both agree that it was quite well thought-out
> the shelves are partly made of full wood, but mostly made of particle- or chipboards – nonetheless this is considered a short-lived material, the shelves were still in very good condition, even though it's an old-fashioned aesthetic
> this shows that it's not only about the material-quality, but also how it is handled and maintained.
> also there are some lamp shades from the original furnishing of the rooms
> based on a personal initiative, he puts them into the dishwasher so they could be used in the future

Additional information (24/04/2020):

Inspector Thomas

Based on memory protocol:

> Since I am here, which is ca. 2 years, the waste-corner was emptied maybe two times
> It costs a lot to empty it
> In this corner should only be metal but people put everything in it
> I also think people that don't live here in the dorm put their waste there
> But in a month or so this corner, the fence and everything will be removed.

[Note: most of the waste there are single beds from IKEA, mattresses and bed-frames which were most likely disposed by previous tenants]
> size of the waste-corner: 1.6m high, 3.6m deep, 5.0m wide = 28.8m³
> emptied ca. once a year

Appendix 6 - Email-Interview Employee Student Housing Organization KKIK

Send: 29/03/2020
Received: 22/04/2020
Interviewee: Janne H.

1) Question (interviewer)
Answer interviewee

DIK + other dorms:

1) How long do people live in average in the dorm rooms in DIK?
   Chresten mentioned ½ – 1 year. This is important as from this number you can say what is the average minimum time furniture will be in use.

Some live there longer. You can live there 6 years.

2) How many of the rooms are rented out at DIK?
   This is important to know if the amount of furniture-waste currently produced is by 70%, 80%, 90% of people who could live here.

Normally all the apartments are rented out.

3) How long do people live in average in the rooms of all your dorms?

Many students live up till 6 years in the dorms.

4) How many of the rooms are rented unfurnished at DIK and in general for all dorms? (percentage)
   Chresten told me at DIK all are rented unfurnished except the ones subrented by Aalborg University. And I went through your website where it is only specifically mentioned for one dorm, that part of the rooms are rented furnished to international students. The majority seems to be rented unfurnished.

100 % when we rent out to AAU they are unfurnished.

Furniture-Waste:

Based on my research at Denmarks Internationale Kollegium (DIK) I perceived that there is a lot of furniture-waste being produced. Even though I expected it could also be more.

5) Does KKIK see furniture-waste as a problem in their dorms?

Not really, most students move from the dorms to another place, where they bring their furnitures. Otherwise they sell their furnitures on DBA or other places like that.

6) Does KKIK have any numbers or statistics on furniture-waste for DIK? Chresten was not able to give any of these numbers – like m³ or tons, he mentioned the times the container is emptied, but not something specific number. And Vestforbrænding didn't reply yet. If you have something, that would be great.

I cannot answer that…..dont know. You should ask in the office at DIK.

7) Can you say how much it approximately costs to take care of the furniture-waste? This question is in that regard relevant, as finding a solution for reuse of furniture might result in lower financially costs for KKIK and the students. Or maybe say how many percent of the rent are for the waste-management? Chresten wasn't able to say that since he mentioned it's paid with the taxes and that I should ask you.

I cannot answer that. Renovation is all garbage. I think furnitures are a very small part of that. Not many students throw out furnitures, as they move to another place where they bring the furnitures.

8) Do you have any numbers or statistics on furniture-waste for your other dorms?

We don't have a lot of furniture-waste, Many of our students are from Denmark, so they just move to another place, bringing their furnitures.

Challenges & Solutions:

9) What kind of initiatives has KKIK initiated to avoid furniture-waste in your dorms?

This is not a thing we do. We don't see a lot of furniture-waste.

10) Why are the rooms offered from KKIK mainly rented unfurnished?/
What does KKIK see as the challenges to rent the rooms with furniture? (for example: staff capacity for the maintenance work; financial effort for you (rent would increase, I guess); it was not requested by the students)

Not many students would prefer to live in a furnished room. Most students want to bring their own furnitures.

11) Would it be possible for KKIK to rent out furnished rooms? For example in a test-phase of maybe 10-50 rooms?
To see with how much effort it would be connected and if it would lead to a decrease in costs for furniture disposal. Respectively how would that change the rent? As I guess it is connected to hiring more staff for, purchase, constructing and maintaining the furniture.

Again ….. it is not a big issue with furniture-waste.

12) Would it be possible to develop a solution that allows the temporary storage of furniture at DIK?
- for example in the basement; containers for furniture on the parking lots; roofs over the waste-container area; in the (partly unused) common areas
13) If not, why? (for example: staff capacity, safety reasons, lack of space)

We don't have staff enough to handle furniture also, and it is not a thing that our tenants ask for.

14) Would KKIK be interested in developing a solution together with the municipality? - for example a second-hand store/repair store for furniture?

We would not be interested, but why don't you ask at a Beboerrådsmøde, maybe some of the persons living there, would do this.

15) *Would it be possible to cooperate with an external company that organizes the furnishing and maintain of the furniture?*

As it is not a thing our tenants ask for, and as this would mean that that rent increases, it would be a thing that the Beboerråd should bring up.

Appendix 7 - Survey Questions

Online Survey
https://docs.google.com/forms/d/e/1FAIpQLScpbvsrQfQM0bUChY0RhttLTPdS31ZVbzFji_r
FmqVGT5Knyg/viewform?usp=sf_link
Local Facebook Group: DIK Albertslund
(https://www.facebook.com/groups/465418806863873/?ref=nf_target&fref=nf)
Open from: 18.-31.03.2020

Text in Survey

Dear fellow DIK'lers,

I am asking you for a few minutes of your time to fill out a survey on furniture waste in
dormitory environments. The survey concerns students, who lived, are going to live or are
currently living Danmarks Internationale Kollegium and their experience and habits
concerning furniture purchase and disposal.
The survey is part of my research for my master thesis in Sustainable Design at Alborg
University. This topic started to intrigue me when I first moved to the SEC about a year
ago, so it finally became my thesis' subject.
It would be better to discuss options and solutions that are less wasteful than the current
system, since we can't switch dimensions (yet), as Rick and Morty. You can contribute by
filling out this survey which will take approximately 10 mins.

Thanks for your help
Kind regards – Tobias

Some terminological explanation:

What is meant by furniture:
Beds, matresses, sofas, sleeping couches, any kind of chairs, any kind of shelves, any
kind of lamps, carpets, pillows and blankets, tables and desks, couch- and coffee-tables,
mirrors, etc.

*https://vignette.wikia.nocookie.net/rickandmorty/images/c/cd/Furniture.png/revi
sion/latest?cb=20160910223642*

What shouldn't be counted in:
Household-items like routers, water-kettles, kitchen equipment etc, are also important

living equipment, but are not part of this research.
You can skip questions that are not answerable or relevant to you.

General Questions:

1) What is your age?
   – younger than 20,
   – 20-25,
   – 26-30,
   – older than 30,
   – don't want to say

2) What is your occupation?
   - Student or apprentice/trainee
   - employee or self-employee
   - others

3) From where did you move to DIK (place of last permanent accommodation)?
   - within Copenhagen area
   - within Denmark,
   - within Europe,
   - From outside of Europe

4) Do you still live at DIK?
   - yes
   - no
   - moving out soon

Move-In/Purchase-Phase

5) Was your room furnished?
   (excluding the objects that were already inside: blinds, shower curtain, toilet seat, built in closet)
   – Yes
   – No
   – partly

6) Did you bring your own furniture when you moved in here?
   – Yes
   – No
   – Partly/ to some extent

7) Did you buy furniture when you moved in?
   – Yes - everything
   – No - nothing
   – Partly – few or many items

8) If yes, which furniture did you buy?
   – bed or mattress,
   – shelve
   – work desk

- office chair
- couch table
- couch
- night desk shelve,
- lamps
- carpet
- other chairs
- mirror
- others pieces of furniture

9) How many pieces of furniture have you bought for your room?
- none,
- 1-2,
- 3-5,
- 6-9
- 10 or more

10) How much did you approximately spend on furnishing the room?
- <1000 DKK;
- 1000-2000 DKK;
- 2000-3000 DKK;
- 3000-5000 DKK;
- more than 5000 DKK
- I don't know;

11) What do you look for when buying furniture – mark the 5 most important factors?
- Quality,
- Functionality,
- Comfort,
- Aesthetic,
- Price,
- Ecological/Environmental considerations,
- Local production
- Easy to transport,
- Easy to assemble,
- Certain brand/store,
- Materials
- Characteristics that influence disposal or resell
- others

12) How did you buy or obtain your furniture for this room?
- bought new at a furniture retailer
- bought used via Facebook
- bought used in store,
- bought used directly from someone else
- was a gift/given away from someone in the dorm (for free)
- picked it up in front of the dorm/at the bins/on the street
- others

13) In case you bought new furniture for your DIK room, where did you buy it?
– IKEA
– JYSK
– online store
– other furniture-retailer

14) How much of your furniture did you buy new (no 2nd-hand) for this apartment/room?
– 0%
– 1-25%
– 26-50%
– 51-75%
– 76-99%
– 100%

15) Do you generally prefer to buy new or used furniture?
– New
– Used
– depends on the type of furniture

16) Would you be open to purchase used furniture in a second-hand shop or a re-sell platform like Facebook?
– Yes
– No
– I did it already

17) What are the drawbacks for you to buy used pieces of furniture?
– hygiene
– not in new/perfect condition
– transport challenges
– distance to the shop
– I don't know where to buy
– lack of choice
– aesthetics doesn't match my expectations
– other considerations

18) Why you buy used furniture (if you do so)?
– it's cheaper
– it's more convenient
– environmental considerations
– others

19) Did you ever pick up a piece of furniture or another items from the street/outside of the dorm blocks (curbside-furniture)?
– Yes
– No

20) What are the drawbacks for you to pick up curbside-furniture?
– I don't do it at all – principally
– it was wet already

- hygienic concerns
- was broken/damaged
- looked too used up
- didn't need it
- not my aesthetic/style
- others

21) Why do/did you pick up curbside-furniture (if you do/did so)?
- I needed it
- it's for free
- it saves resources
- it's convenient – low transport effort
- I liked the aesthetic
- others

22) Which kinds of furniture would you not buy, take as a gift or pick-up for free in used condition?
- bed or mattress,
- upholstered chairs
- chairs in general,
- shelves
- carpets
- electric items (incl. Lamps etc.)
- others

23) Do you know there is a Red-Cross-Store just around the corner in Albertslund Center (less than 500 m from DIK), where you can buy or bring used items like clothes and household items (but not furniture)?
- Yes,
- No

24) Are you familiar with places where you can bring old furniture or take used ones for free, such as Genbruggstation / Recycling Center (2km from the dorm) in Albertslund?
- Yes,
- No

25) Would you pick up furniture from there for free if you knew about it?
- Yes,
- No,
- maybe

26) If not, why?
- too much effort (e.g. transport)
- lack of choice
- others

27) Would you prefer to rent a furnished room?
- Yes,
- No,

– Yes, If I can choose from a variety of furniture

28) What do you see as the biggest disadvantages of renting an unfurnished room in the dorm?
– It costs too much money to buy furniture
– It takes time to get the furniture to the dorm
– It's quite an effort to get the furniture to the dorm and build it up
– The rooms are completely empty upon arrival and the period until the purchase of furniture is inconvenient living
– You have to take care of the disposal of the furniture after move-out
– other reasons

29) What do you see as the biggest advantages of renting an unfurnished room in the dorm?
– I can freely choose what to put in
– I already have furniture, so I don't need to use what's in
– other reasons

After your stay:

30) If you moved out already: Where did you move to?
– within Copenhagen area,
– within Denmark,
– within Europe,
– to other parts of the world

31) Will you take/Have you taken the furniture with you?
– Yes,
– no,
– some of it
– I don't know yet

32) How long did you live/have you lived so far in this dorm?
– less than 6 months;
– 6-12 months,
– 13-24 months;
– more than 2 years

33) How long have you used most of your furniture (so far)?
– less than 6 months;
– 6-12 months,
– 13-24 months;
– more than 2 years,
– I don't know

34) Which of the methods do you use to get rid of your furniture after/when you move(d) out?
– sell it on Facebook,
– sell it on another platform
– sell or give it directly to somebody else

–   put it on the street/in front of the trash bins (curbside waste)
–   throw it into the bins or waste-corner
–   bring it to or let it pick up by a donation/reuse center
–   bring it to or let it pick up from recyclers/recycling center/ Genbruggstation
–   other way

35) Have you thrown-out your furniture after your stay at DIK?
–   Yes, Most of it
–   Yes, some of it
–   Yes, a few items
–   No, nothing

36) If yes, why?
–   I didn't need it anymore
–   I didn't know about reselling options like the DIK-facebook chat or DBA
–   I didn't know about other donation options
–   I didn't know about professional recycling options
–   it was too much effort to put it up to resell, donation or recycling
–   it was the quickest and most convenient way
–   I put next to the bins so someone could reuse it
–   I needed the furniture until I moved out so it was hard to put it into the re-use
    system
–   others:

37) Would you use any of the services for donation of furniture instead of disposal to
    social organizations as the recycling-center or Red-Cross, when they would pick it
    up and it wouldn't cost you anything?
–   Yes
–   No
–   Maybe
–   I don't know

38) Which of the sustainable furnishing options for you room would you prefer, when
    living here for 3-12 months? Please choose one:
–   Pre-furnished Room with basic furniture (single bed, one lamp, one table, one chair,
    one coffee table; no choice of furniture, but lower price than buying new: for
    example additional fee of 150 DDK/month)
–   Buying used from local second-hand-shop or platform like Facebook (limited choice
    of furniture/ no certainty if desired piece of furniture are available; little transport
    effort (e.g. delivery); ca. Half the price of new furniture)
–   Buying used furniture from DIK (stored and maintained furniture of previous tenants;
    bigger variety than in local second-hand store; almost no transport effort; ca half
    the price of new furniture)
–   Leasing furniture from an external company (furniture would be delivered on moving
    in day; big variety of furniture to choose from; same price as buying new furniture or
    a little more expensive)
–   Buying new sustainably produced furniture (made from environmentally friendly
    materials and fair-trade production; delivery to dorm; ca. Twice the price of other
    new furniture)

39) Do you see furniture waste as a problem?
 – Yes,
 – No,
 – No opinion on that issue,

40) What do you see as the biggest challenge to avoid furniture-waste in your situation?

41) Other comments:

Thanks for your participation. It has been a long journey, but you helped with your info to discuss options and solutions that are better for future tenants and the environment.

Appendix 8 - Answers Survey Furniture Waste in Dormitory Environments

Question 1:

What is your age?
36 Antworten

- younger than 20
- 20-25
- 26-30
- older than 30
- don't want to say

22,2%
8,3%
69,4%
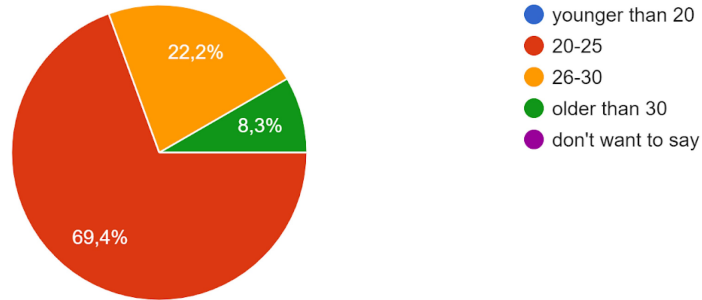
Question 2:

What is your occupation?
36 Antworten

- Student or apprentice/trainee
- employee or self-employee
- others

16,7%
83,3%
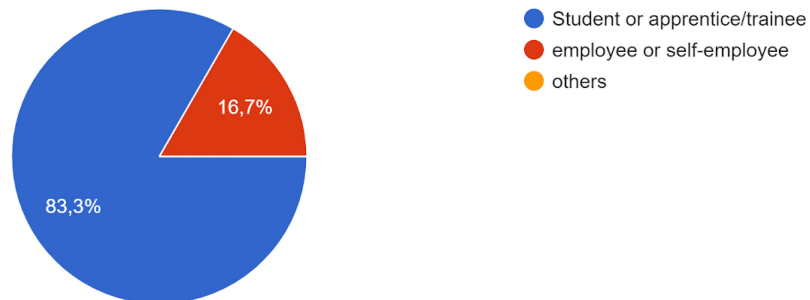
Question 3:

From where did you move to DIK (place of last permanent accommodation)?
36 Antworten

- within Copenhagen area
- within Denmark
- within Europe
- From outside of Europe

44,4%
11,1%
38,9%
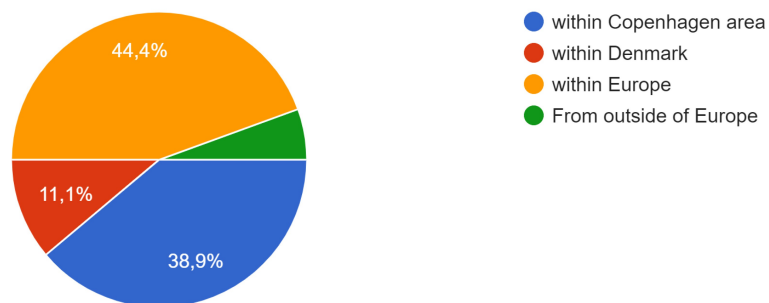
Question 4:

Do you still live at DIK?

36 Antworten

- yes
- No
- moving out soon

27,8%
13,9%
58,3%
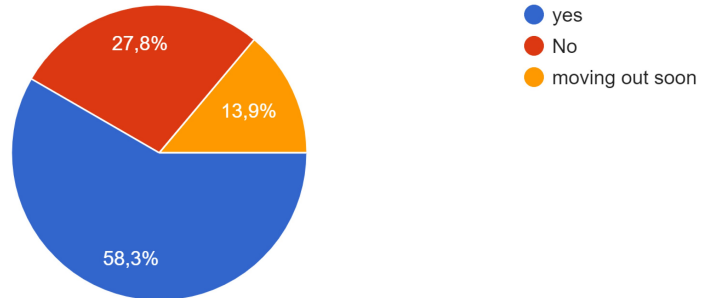
Question 5:

Was your room furnished? (excluding the objects that were already inside: blinds, shower curtain, toilet seat, built in closet)

36 Antworten

- Yes
- No
- Partly

75%
8,3%
16,7%
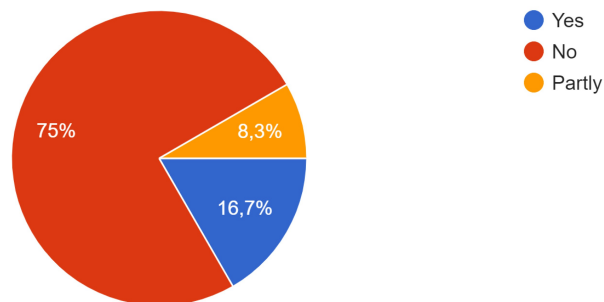
Question 6:

Did you bring your own furniture when you moved here?

36 Antworten

- Yes
- No
- Partly

38,9%
16,7%
44,4%
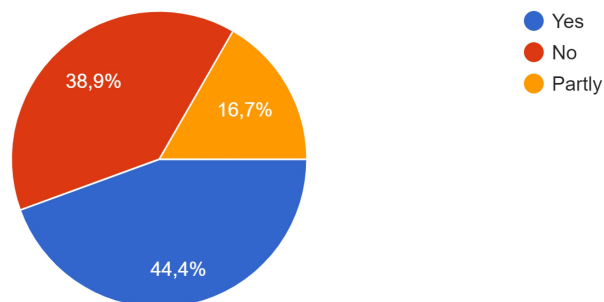
Question 7:

Did you buy furniture when you moved in?
36 Antworten

- ● Yes - everything
- ● No - nothing
- ● Partly – few or many items

72,2%

19,4%

8,3%
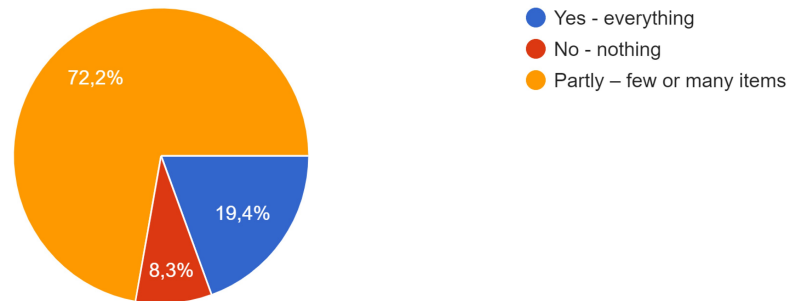
Question 8:

If yes, which furniture did you buy?
32 Antworten

bed or mattress	
shelve	
work desk	
office chair	
other chairs	
couch	
couch table	
night desk shelve	
lamps	
carpet	
mirror	
Closet	
bookshelf	
Dinner table	
Large Cabinet	
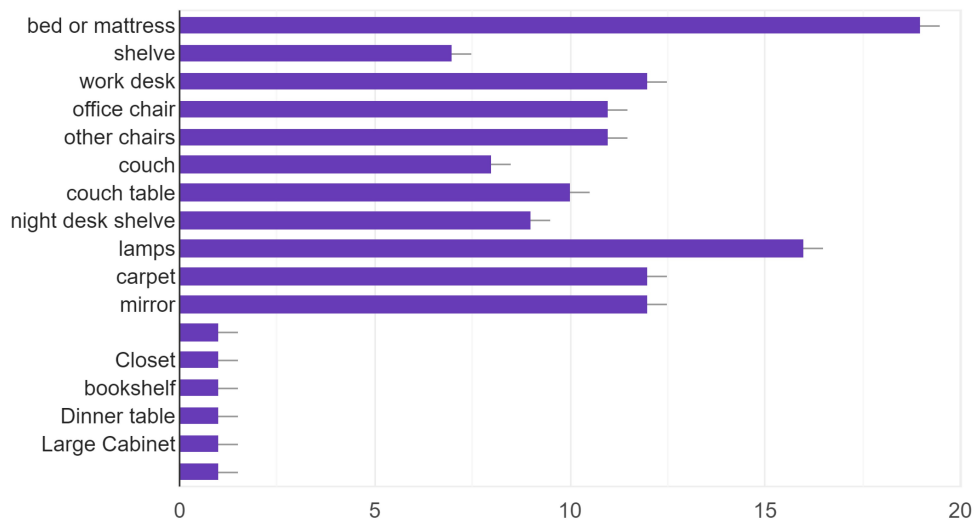
Additional Answers:
- *Large Cabinet*
- *clothes hanger, shower curtain, pillow*
- *Rack of clothing, and clothing drawers*
- *Closet*
- *Dinner table*
- *bookshelf*

Question 9:

How many pieces of furniture have you bought for your room?

36 Antworten

- none
- 1-2
- 3-5
- 6-9
- 10 or more

16,7%
19,4%
27,8%
30,6%
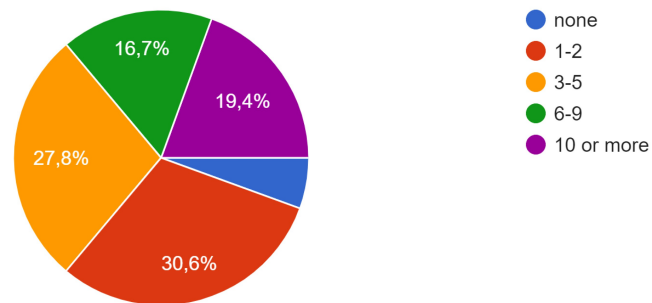
Question 10:

How much did you approximately spend on furnishing the room?

36 Antworten

- less than 1000 DKK
- 1000-2000 DKK
- 2000-3000 DKK
- 3000-5000 DKK
- more than 5000 DKK
- I don't know

16,7%
58,3%
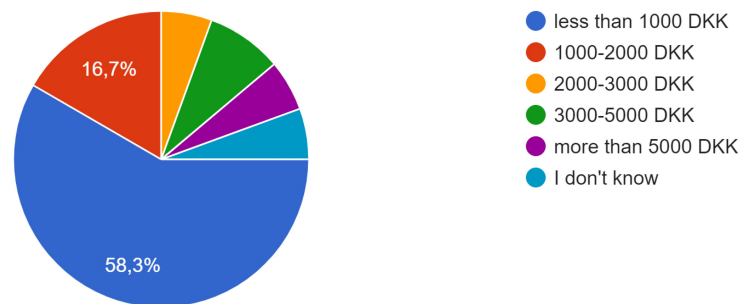
Question 11:

What do you look for when buying furniture – mark the 5 most important factors?

36 Antworten
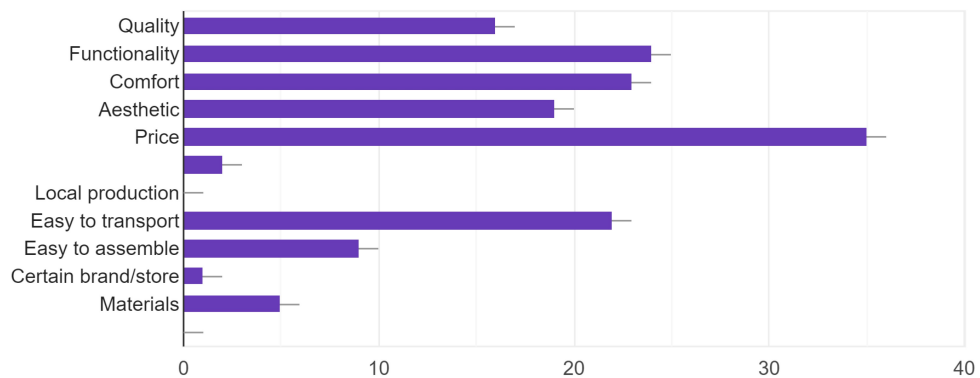
Environmental Considerations: 2

Question 12:

How did you buy or obtain your furniture for this room?
36 Antworten
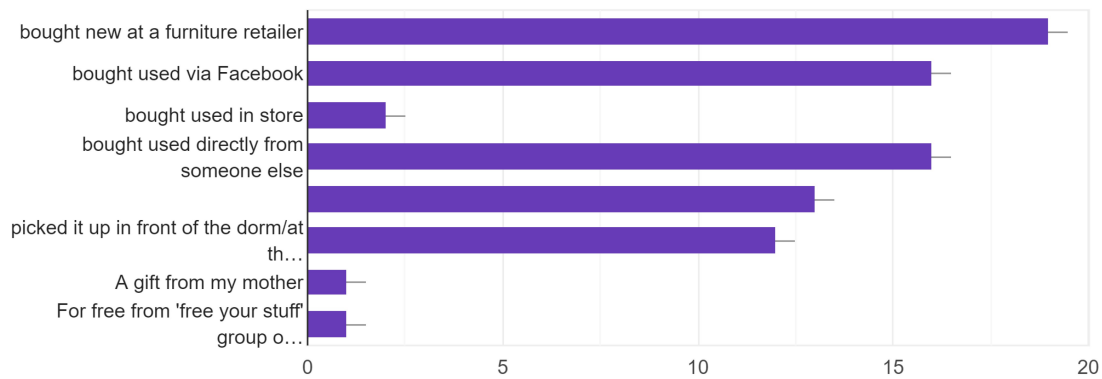
Additional Answers:
- A gift from my mother
- For free from 'free your stuff' group on facebook

Question 13:

In case you bought new furniture for your DIK room, where did you buy it?
25 Antworten
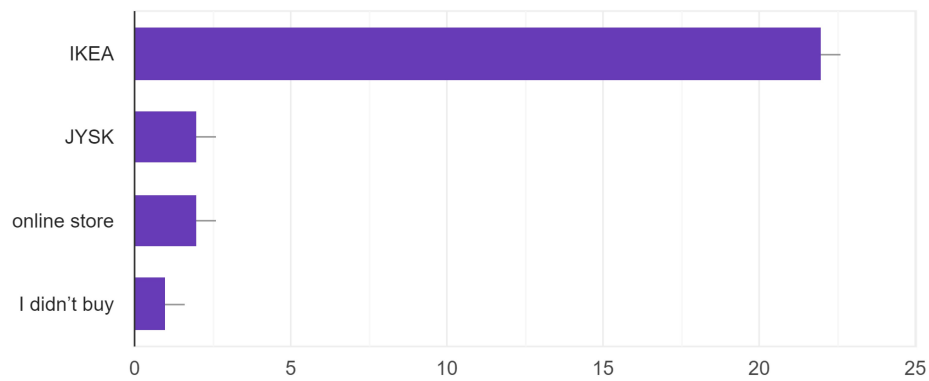
Additional Answers:
- I didn't buy

Question 14:

How much of your furniture did you buy new (no 2nd-hand) for this apartment/room?

36 Antworten

- 0%
- 1-25%
- 26-50%
- 51-75%
- 76-99%
- 100%

41,7%

11,1%

36,1%
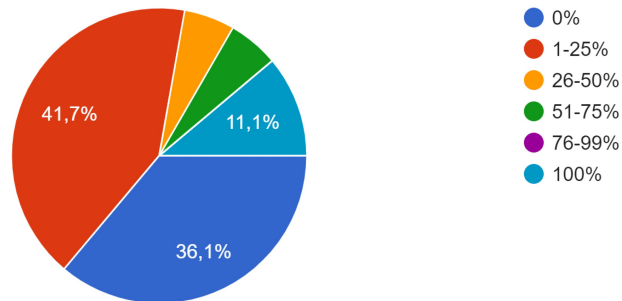
Question 15:

Do you generally prefer to buy new or used furniture?

36 Antworten

- New
- Used
- Depends on the item

77,8%

16,7%
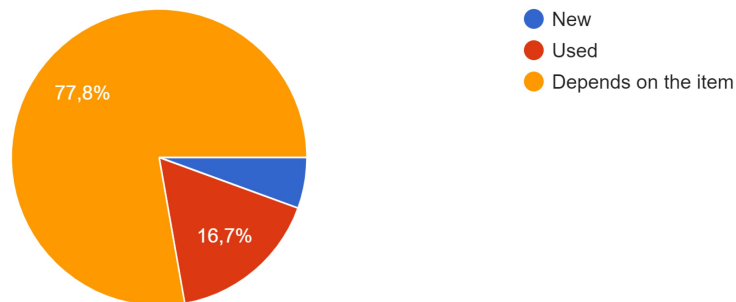
Question 16:

Would you be open to purchase used furniture in a second-hand shop or a re-sell platform like Facebook?

36 Antworten

- Yes
- No
- I did it already

47,2%

52,8%
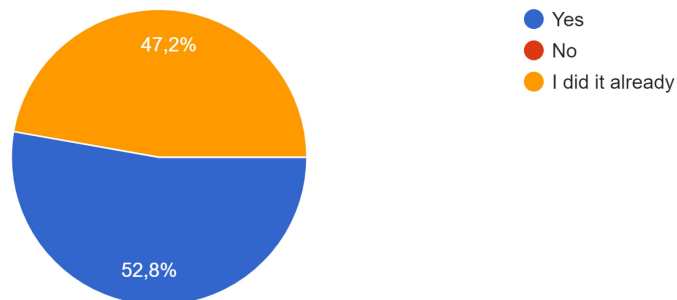
Question 17:

What are the drawbacks for you to buy used pieces of furniture?
34 Antworten
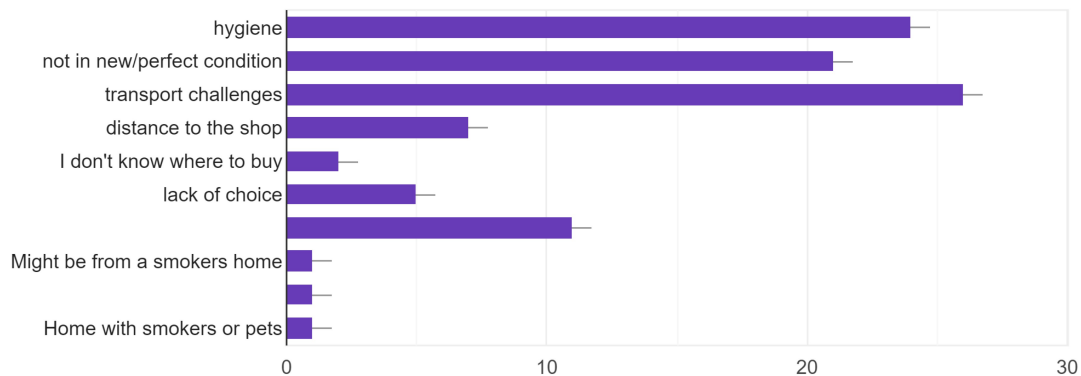
Additional Answers:
- *Might be from a smokers home*
- *Home with smokers or pets*
- *Possibility of bed bugs infestation which is quite often in DIK. After seeing so many cases I am more reluctant to buy second hand*
- *May be impossible to find an exact choice at the shop*

Question 18:

Why do you buy used furniture (if you do so)?
35 Antworten
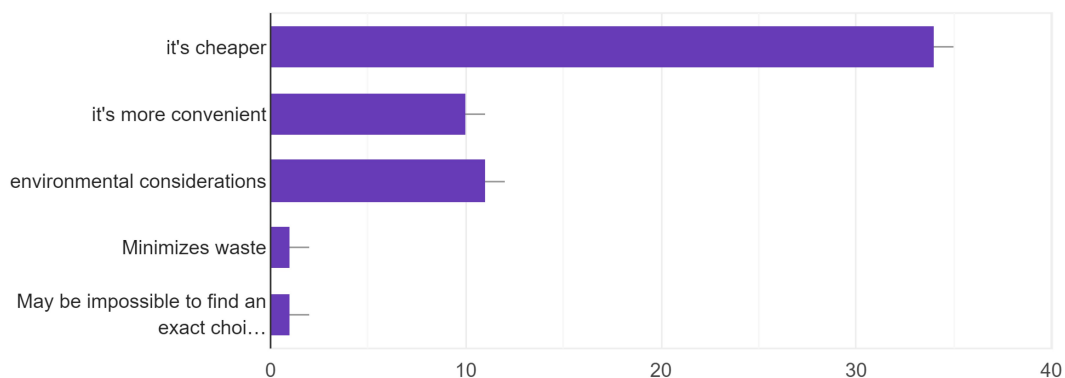
Additional Answers:
- *Minimizes waste*
- *May be impossible to find an exact choice at the shop*

Question 19:

Did you ever pick up a piece of furniture or another items from the street/outside of the dorm blocks (curbside-furniture)?

36 Antworten

- ● Yes
- ● No

47,2%

52,8%
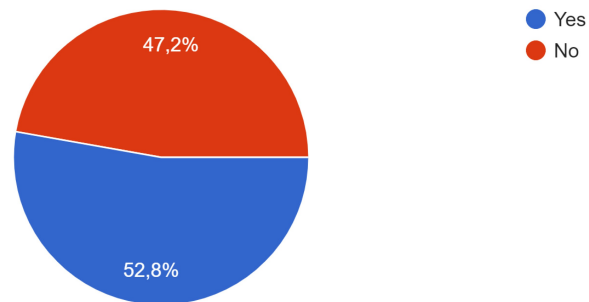
Question 20:

What are the drawbacks for you to pick up curbside-furniture?

31 Antworten
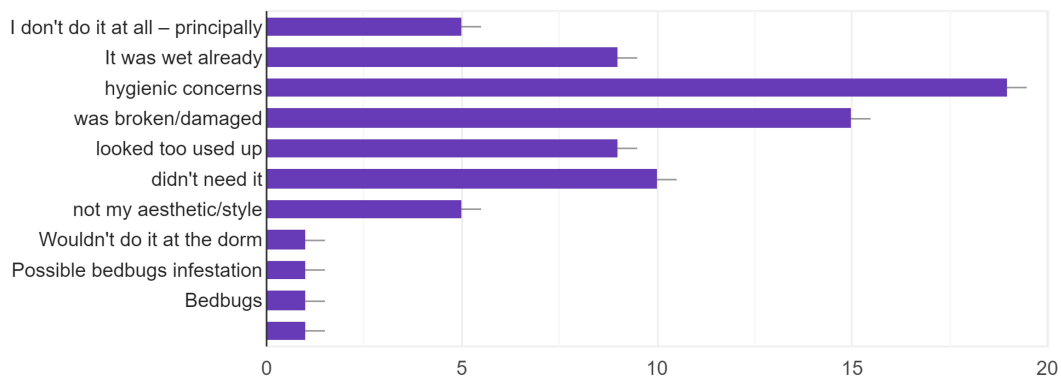
Additional Answers:
- *Wouldn't do it at the dorm*
- *I would never pick up furniture from the streets as i have personal experience with bedbugs and you can never trust what the reason is for the furniture to be thrown out*
- *Possible bedbugs infestation*
- *Bedbugs*

Question 21:

Why do/did you pick up curbside-furniture (if you do/did so)?

24 Antworten
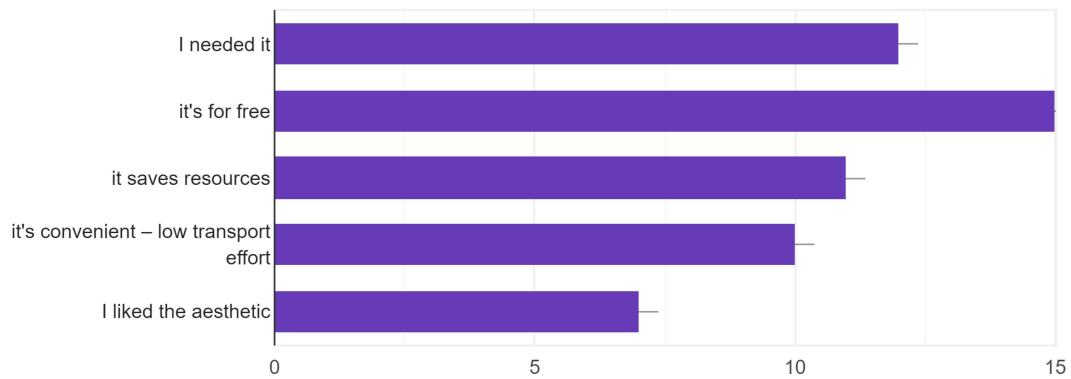
Question 22:

Which pieces of furniture would you not buy, take as a gift or pick-up for free in used condition?

28 Antworten
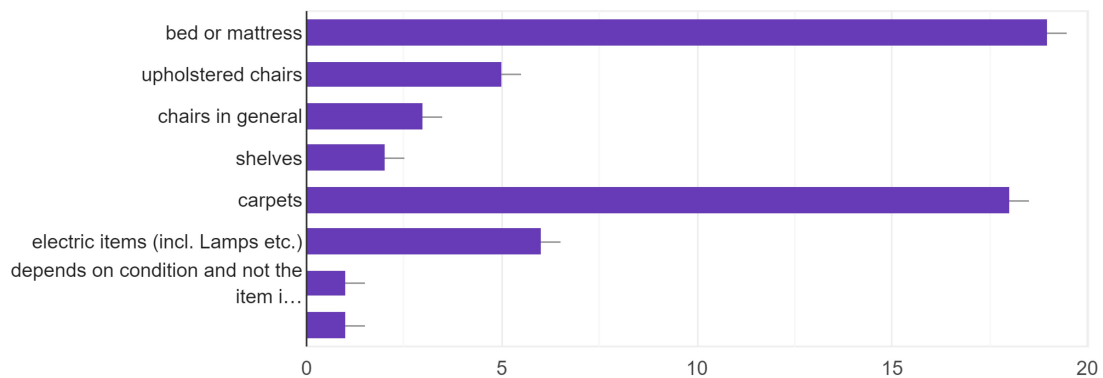
Additional Answers:
- *I would probably pick up a frame for a bed, but not the mattress* (10)
- *depends on condition and not the item itself* (12)

Question 23:

Do you know there is a Red-Cross-Store just around the corner in Albertslund Center (less than 500 m from DIK), where you can buy or bring used i... clothes and household items (but not furniture)?

36 Antworten

- Yes
- No

19,4%

80,6%
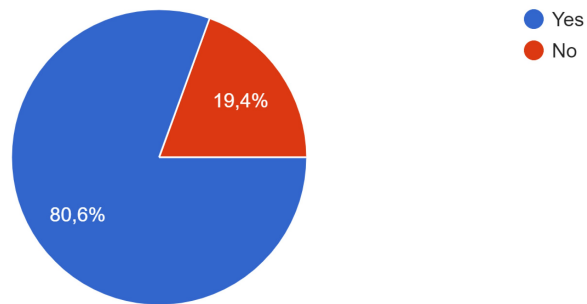
Question 24:

Are you familiar with places where you can bring old furniture or take used ones for free, such as Genbruggstation / Recycling Center (2 km from the dorm) in Albertslund?

36 Antworten

- Yes
- No

86,1%

13,9%
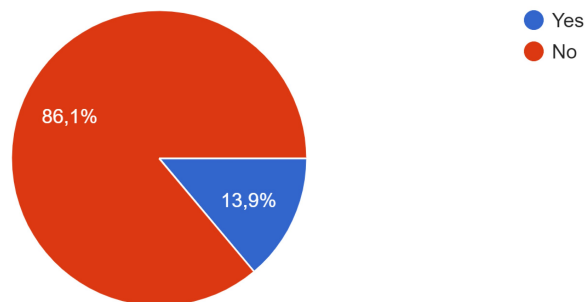
Question 25:

Would you pick up furniture from there for free if you knew about it?

36 Antworten

- Yes
- No
- Maybe
- If there would be a garanti that it's not infested with bedbugs. I know I am crazy with the bedbugs

47,2%

8,3%

41,7%

Additional Answer:
- If there would be a garanti that it's notinfested with bedbugs. I know I am crazy with the bedbugs"

Question 26:

If not, why?
13 Antworten
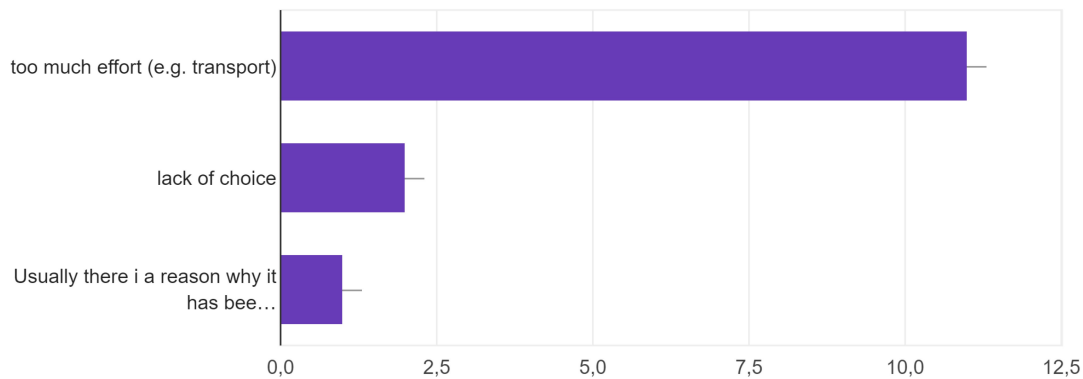
Additional Answer: "*Usually there i a reason why it has been there.*"

Question 27:

Would you prefer to rent a furnished room?
36 Antworten

- Yes
- No
- Yes, If I can choose from a variety of furniture
- Maybe
- Yes, if the furniture won't be to used up. But for DIK this would probably mean extra cut down from the deposit for damages and running down the furniture.
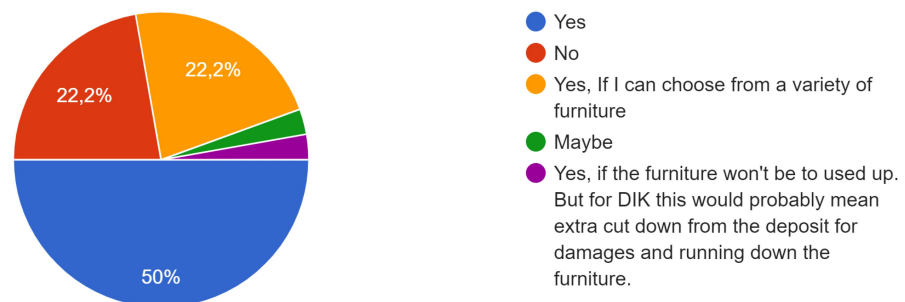
Additional Answer:
- Maybe
- Yes, if the furniture won't be to used up.But for DIK this would probably mean extra cut down from the deposit for damages and running down the furniture.

Question 28:

What do you see as the biggest disadvantages of an unfurnished room in the dorm?
36 Antworten
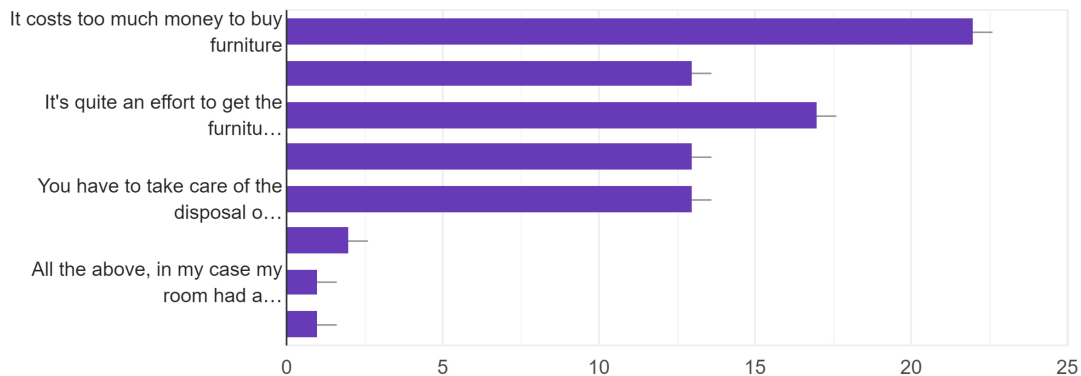
Additional Answer:
All the above, in my case my room had a worktable, bed and chair upon arrival which felt for me as enough considering forniture needed. To get in detail, I found a sofa ouside which i still have and purchased a small table and a mirror to two different people moving out from the dorm. Also have one more chair, lamp and two small table that were offered by people who left the dorm as well.

Question 29:

What do you see as the biggest advantages of an unfurnished room in the dorm?
36 Antworten
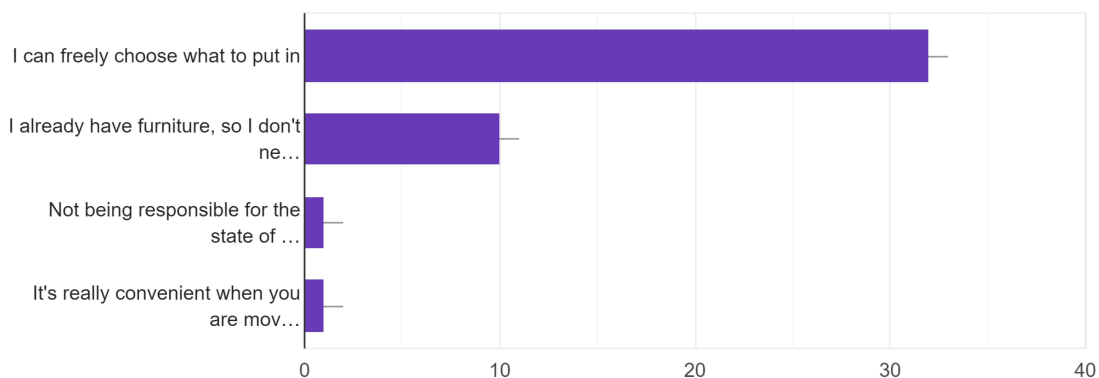
Additional Answers:
- Not being responsible for the state of the furniture upon leaving even though that has not been an isse
- It's really convenient when you are moving out from an apartment and you are taking your furniture with you. If the apart you move in is already furnished you need to dispose all your furniture

Question 30:

If you moved out already: Where did you move to?
18 Antworten
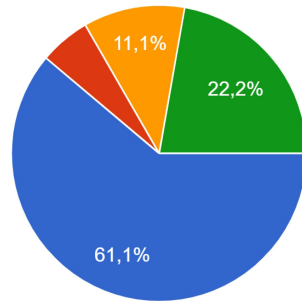
- within Copenhagen area
- within Denmark
- within Europe
- to other parts of the world

11,1%
22,2%
61,1%

Question 31:

Will you take/Have you taken the furniture with you?
36 Antworten

- Yes
- No
- Some of it
- I don't know yet

19,4%
30,6%
11,1%
38,9%
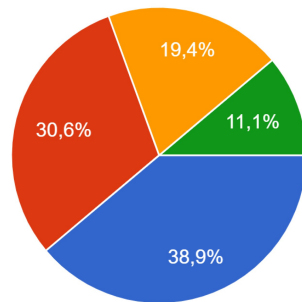
Question 32:

How long did you live/have you lived so far in this dorm?
36 Antworten

- less than 6 months
- 6-12 months
- 13-24 months
- more than 2 years

38,9%
13,9%
16,7%
30,6%
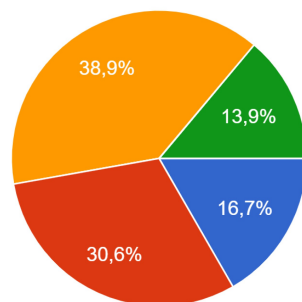
Question 33:

How long have you used most of your furniture (so far)?
36 Antworten

- less than 6 months
- 6-12 months
- 13-24 months
- more than 2 years

25% (13-24 months)
25% (more than 2 years)
11,1% (less than 6 months)
38,9% (6-12 months)
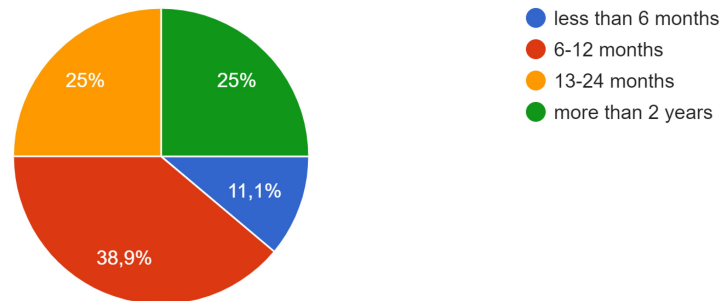
Question 34:

Which of the methods do you use to get rid of your furniture after/when you move(d) out?
36 Antworten

- sell it on Facebook
- sell it on another platform
- put it on the street/in front of the wa…
- bring it to or let it pick up by a dona…
- I will take it with me
- Probably I will take with me only some …
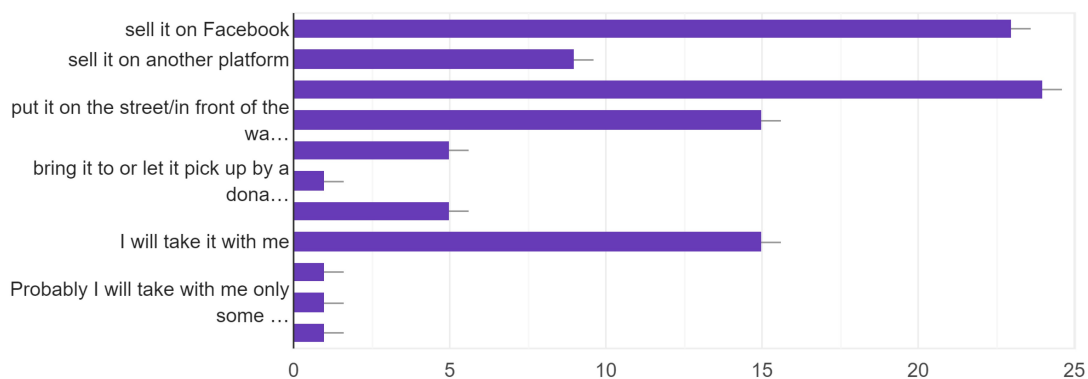
Additional Answers:
- would try to to giveaway through facebook or talking with people i know in the dorm and last resort leave outside and post it in more general groups such as free your stuff copenhagen
- Probably I will take with me only some items that are in better shape

Question 35:

Have you thrown-out your furniture after your stay at DIK?
22 Antworten

- 🔵 Yes, Most of it
- 🔴 Yes, some of it
- 🟠 Yes, a few items
- 🟢 No, nothing

63,6%

31,8%
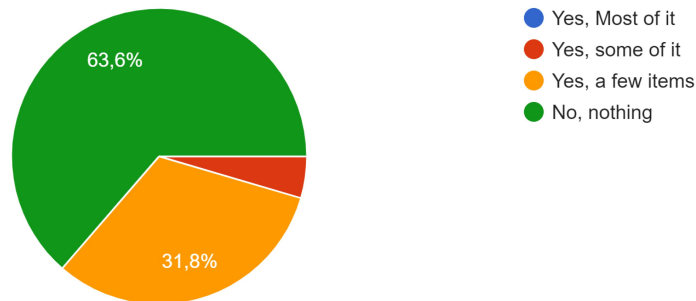
Question 36:

If yes, why?
9 Antworten

I didn't need it anymore	3
I didn't know about reselling options I…	0
	1
I didn't know about professional recycl…	2
	1
it was the quickest and most convenient…	3
	4
I needed the furniture until I moved ou…	2
Too worn out	1
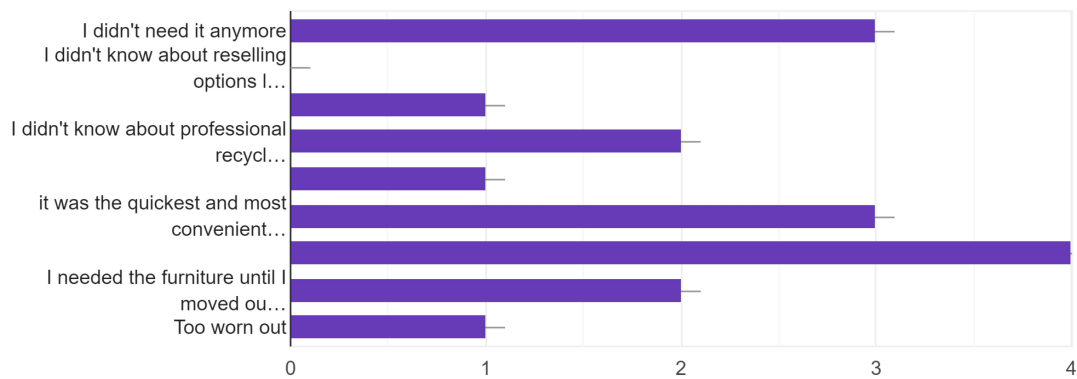
Additional Answers: *Too worn out*

Question 37:

Would you use any of the services for donation of furniture instead of disposal to social organizations as the recycling-center or Red-Cross,...ould pick it up and it wouldn't cost you anything?
33 Antworten

- 🔵 Yes
- 🔴 No
- 🟠 Maybe
- 🟢 I don't know

27,3%

9,1%

63,6%
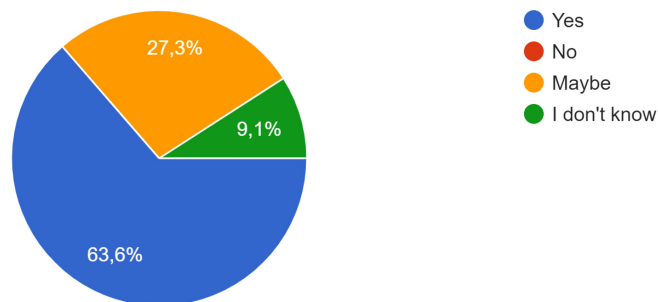
Question 38:

Which of the sustainable furnishing options for you room would you prefer, when living here for 3-12 months? Please choose one:

36 Antworten
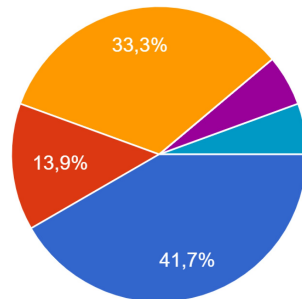
- Pre-furnished Room with basic furniture (single bed, one lamp, one table, one…
- Buying used from local second-hand-shop or platform like Facebook (limite…
- Buying used furniture from DIK (stored and maintained furniture of previous t…
- Leasing furniture from an external company (furniture would be delivered…
- Buying new sustainably produced furn…
- Pre-furnished Room with basic furnitur…

Question 39:

Do you see furniture waste as a problem?

36 Antworten
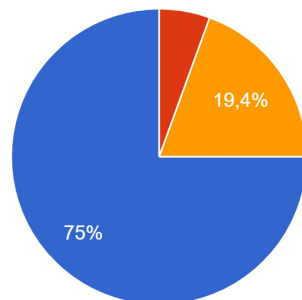
- Yes
- No
- No opinion on that issue

Question 40:
What do you see as the biggest challenge to avoid furniture-waste in your situation?
16 Answers

- I would never have bought brand new furniture if the room was already furnished with the essentials, bed frame, table, cabinet, bookshelf and chair.

- People don't think about it. If there is a new furniture coming, they just want to throw out the old one because they need space and don't have time/patient to give away the old one.

- after my stay here what can i do with the furniture

- I plan to move out of Denmark and i won't take any furniture with me.
- I don't have a car so I wouldn't be able to give it to someone, but I'll do my best to give it away or sell it as long as they come here-

- Self-organization

- I have used the same furniture since i was 13, with some additions (bought/gifted to me pre-used), so i don't have a lot of experience with getting rid of it.

- Bed bugs and quality of material made so they can last longer

- Lack of structure and ideas on how to avoid futniture-waste after it's not needed

- Bad quality furniture that is run down easily, the fast change of furniture style, the mind set that its a disposable item

- Recycling and resale of use items. Students moving out should be responsible for recycling items (maybe give it away to a local second-hand furniture store or another student) and not just throw it away

- The weight of furniture

- Transportation

- Not to buy anything new till I move to an apartment. I'm not planning to take anything with me then. That way I can save money to buy something new and last longing in the long term. And I can give the things I have now away..

- lack recycling places to get of rid of or proper places to leave them

Question 41: Comments / Improvement suggestions
5 Answers

- Cooperation of DIK with used furniture retailers, Rooms in DIK should come furnished

- The fact that you can't leave your furniture to the next tenant is wasteful. I think it would really nice to offer the next tenant the option to keep all or some items of their choise. A lot of furniture is thrown out because it can't be let in the dorm and is left outside where is damaged by rain before the new tenants come.

- Storing furniture could be a hazard because of bedbugs, especially in Dik

Appendix 9 - Furniture & Household Waste Documentation Charts

Time: February-April 2020

Furniture & Furniture Equipment Discarded
> Kitchen Furniture (chairs + tables not included)
> only furniture counted that was discarded and reused outside of the blocks at the waste-bins or the waste-corner

DC = Desk Chair
AC = Arm Chair
CT = Coffee/ Couch-table
FR = Foot rest
FM = Folding / Inflatable Mattress
dis. = disassembled

Image- No	Total Amount	Bed / Bed-frame	Mattress	Chair	Sofa or Sofa-bed	Desk/Table	Shelve	Blind	Lamp	Carpet	Others	Furniture-Equipment (What?)	Condition						Reused		
													Directly usable	Needs Cleaning	Needs repair/refurbishment	Only Parts usable	Recyclable	Not clear	Yes	No / in bin	not clear
F-1	**1**		1											1 (wet)							1
F-2	**1**	1														1					1
F-3	**1**			1												1					1
F-4	**2**							2										2		2	
F-5	**1**											1 Woodboard				1					1
F-6	**1**	1												1 (wet)							1
F-7	**2**											2 Pillows		2 (wet)							2
F-8	**1**			1										1 (wet)						1	
F-9	**1++**											1 clothes hangers (3)	1						*1 (Me)*		1
F-10	**1**	1													1					1	

F-11	1			1 (DC)											1				1	
F-12	1		1											1 (wet)						1
F-13	1					1 (CT)								1			1 (Me)			
F-14	3						2				1 Woodboards (2)			2 (wet)		1	1	2		
F-15.1	1	1												1						1
F-15.2	3			1 (FR)		1 (CT)				1		2	1				3			
F-15.3	1											1 Pillow	1							1
F-16	1					1							1				1			
F-17	1										1 clothes stand		1					1		
F-18	1										1 Woodboard					1				1
F-19	1			1												1				1
F-20	2							2						2				2		
F-21	1						1							1						1
F-22	3							1	1		1 Table-Legs (4)					1 (t.l.)	2	3		
F-23	1										1 Part from Bed					1				1
F-24	1							1									1	1		
F-25	1	1													1*			1		
F-26	1											1 Bedclothes	1					1		
F-27	1						1								1 (dis.)			1		
F-28.1	2											2 Couch pillows	2					2		
F-29	1		1										1					1		
F-30	1	1													1 (dis.)			1		
F-31	2									2			2					2		

F-Nr.																					
F-32	1										1 clothes stand						1*			1	
F-33	1	1														1 (dis.)					1	
F-34	1			1															1*		1	
F-35	1		1 (FM)											1 (got wet)							1
F-36	1										1 Piano (Made in Denmark)				1 *						1
F-37	2		1								1 Mirror (glass broken)			1 (m. wet)	1					1	1
F-38	1		1 (FM)												1					1	
F-39	1						1								1						1
F-40	2					1						1 Shower curtain rail			1				1	2	
F-42	1			1											1					1	
F-43	2					2								2						1	1
F-44	3						1					2 Pillows		2	1				1	2	
F-45	1		1													1				1	
F-46	4					4													4	4	
F-47	1		1													1				1	
F-51	1				1 (CT)								1								1*
F-52	9	1	2	1		2	1		1		1 Mirror		1	2	4	1		1	4	2	3
A shelve, A bed with two mattresses, a coffee table, a desk, an office chair, two paintings an IKEA bag with three helmets and a bag, a mirror, two stools, an ironing board, a lamp, a broom – most of it can be identified as IKEA by design or label; most of it seemed in usable condition, except that it was wet now due to the exposure to rain																					
F-53	1			1									1						1 (Me)		
F-54	5	1		2	1			1					1	1	2	1			2	1	2
F-55	1						1								1 (dis.)					1	
F-56	1											1 Floor protector f. desk			1						1
F-57	12			3		3	4		1		1 Mirror		7	3	1			1	4	1	7
Three chairs, one desk, one couch-table, a garden table, a TV shelve, a book shelve, a desk trolley, a lamp, a bathroom shelve household-items, a mirror -																					

a lot of the household-items were reused/gone by next day; two people were observed carrying a shelve, a blanket																				
F-58	**4**	1	1								1Bedclothes, 1 mattresses protector		3		1				4	
F-59	**2**					1					1 Mirror			2					1	1
F-60	**1**					1 (CT)								1						1
F-61	**1**						1						1							1
F-62	**2**							2								2			2	
F-63	**1**								1							1			1	
F-64	**3**							3								3			3	
F-65	**1**	1												1						1
F-66	**1**						1					1								1
F-67	**1**		1										1						1	
F-68	**1**		1 (FM)										1						1	
F-69	**1**						1					1						1*		
F-70	**4**	1				1	1		1			1	2			1		3		1
F-71	**1**				1								1						1	
F-72	**6**							6								6			6	
F-73	**1**					1 (CT)								1						1
F-74	**2**	2											1	1						2
F-75	**1**					1 (CT)							1							1
F-77	**1**								1							1				1
F-78	**1**										1 Part of clothes stand				1				1	
F-79	**1**									1			1							1
F-80	**1**			1 (AC)									1						1*	
F-81	**1**					1						1						-	-	-
F-82	**1**	1											1						1	

F-83	1										1 White board			1					1	
H-4	1							1									1		1
H-5	2	1 (FM)										1Shower curtain		2					2	
F-84	1										1 Foldable wardrobe			1					1	
H-11.1	1				1									1						1
F-85	2											1 Shower curtain, 1 shower hose		2					2	
F-87	1											1 pillow						1		1	
H-46.4	2											2 Chair pillows		2						2
F-88	3++						1					1 hangers (5), 1 basket from closet	1	1				1	3++	
F-89	1				1									1						1
F-90	1										1 Wood frame			1						1
F-91	1				1									1				½ (legs)	½	
F-92	1			1										1					1	
F-93	1				1								1 (as new)					1*		
F-94	1							1						1 (wet)					1	
F-95	1		1											1					1	
F-96	1					1											1		1	
F-97	1											1 pillow		1					1	
F-98	2					2								2					2	
F-99	2			1	1									1	1				2	
F-100	1				1									1						1
F-101	1							1										1	1	
Total Amount																				

Image-No	Amount	Bed / Bed-frame	Mattress	Chair	Sofa or Sofa-bed	Desk/Table	Shelve	Blind	Lamp	Carpet	Others	Furniture-Equipment (What?)	Condition						Reused		
													Directly usable	Needs Cleaning	Needs repair/refurbishment	Only Parts usable	Recyclable	Not clear	Yes	No/in bin	not clear
Amount	**164**	15	13	16	5	21	17	25	8	7	16	21	20	57	40	15	3	29	24 1/2	88 1/2	52
%	**100,00%**	~9.1%	~7.9%	~9.8%	~3.00%	~12.8%	~10.4%	~15.2%	~4.9%	~4.3%	~9.8%	~12.8%	~12.2%	~34.8%	~24.4%	~9.1%	~1.8%	~17.7%	~14.8%	~53.6%	~31.5%
Others				3 Woodboards; 3 clothes stand/parts of; 1 Table-Legs; 1 Part from Bed; **1 Piano** (Made in Denmark); 4 Mirrors; 1 White board; 1 Foldable wardrobe; 1 Wood frame,																	
Furniture-Equipment				1 Pillows (normal, sofa, chair); 2 clothes hangers; 2 Bedclothes; 1 mattresses protector ; 4 Shower equipment (curtain, hose, rail); 1 basket from closet; 1 Floor protector f. desk																	

Notes:

What was reused:
italics – reused by me
² – directly observed to be reused (3x)

Clothes Hangers (F-9); a coffee-table (F-13*)*; A shoe shelve (F-14); coffee-table (F-15.2); carpet (F-15.2); foot-rest (F-15.2); a wooden desk (F-16); one carpet (F-43); shelve (F-44), a mirror (F-52), a shelve (F-52), an office chair (F-52) ; *a stool (F-53*)*; 2 office chairs (F-54); a book shelve (F-57²), a lamp (F-57), a desk trolley (F-57); a garden table (F-57); a bathroom shelve (F-57); desk-trolley (F-69²); *a shelve (F-70*)*; a table (F-70); a lamp (F-70); table-legs (F-91); F-93 (a desk²)

Discarded inside Bins:
F-4 (blinds); F-20 (blinds); F-22 (blinds, table-legs, broken lamp); F-24 (blinds); F-26 (bed clothing); F-27 (disassembled shelve); F-30 (part of the disassembled bed); F-31 (carpets); F-38 (inflatable mattress); F-52.10 (stool); F-53 (stool); F-55 (metal shelve); F-62 (blind); F-63 (old lamp from rooms); F-64 (table legs from F-59 + blinds); F-72 (blinds); F-76 (pinboards); F-85 (shower-curtain); F-87 (pillow); F-88 (clothes hangers, blind, basket from built-in wardrobe); F-101 (lamp)

Disassembled:
F-22 (table legs); F-27 (shelve); F-30 (bed-frame); F-32 (by inspectors); F-33 (bed-frame); F-47 (mattress); F-55 (metal shelve); F-67 (bed-frame metal at waste-corner); F-84 (foldable wardrobe); F-96

*Other comments:
F-25 – by owner repaired with cable binders
F-34 – was destroyed by drunken people in block
F-36 – Piano (made in Denmark) left in almost perfect condition in front of block; was standing there for 10 days, got wet, was partly played and decreased in quality over time (from very good to needs repair), until it was gone/picked up
F-47 - mattress which was put in front of bins disassembled – metal parts, upholstery, cover separated – shows mattresses could be refurbished when designed like this
F-49 – still lying in dormblock
F-51 - posted on Facebook before
F-76 – taken out of bin for reuse by me
F-80 – removed after 10 days
F-91 + F-92 – perfect examples how low material-quality (MDF) is contributing to rendering the furniture as waste prematurely
F-99 – good example for mixed materials

Brands:
identifiable as IKEA (Design or Label)
F-12; F-14 (2); F-15.2; F-22 (table-legs); F-27; F-29; F-30; F-32; F-33; F-37 (1); F-41 (2); F-52 (4); F-53; F-57-2 (table); F-58 (2); F-60; F-66; Beds in the Waste-corner; F-70 (4); F-73; F-78; F-79; F-82; H-31; H-38; H-46.4; H-46.2; H-53; H-57; H-63; H-70; F-92; F-93; F-99 (1)

Most Likely IKEA:
F-2; F-25; F-39; F-37 (1); F-45; F-52 (2)

Jysk:
all blinds; F-35; F-57-1 (table)

Others:
Samsoe & Samsoe (F-9); Sentou (F-13); BoConcept (F-34); Netto (F-77);

Chart - Packaging of Furniture (Consumption)

Brand	Amount	Percent
IKEA	11	~58%
JYSK	5	~26%
Innovation Living A/S	1	~5%
Kartell	1	~5%
Svive	1	~5%

Counting of Household-Items etc.

++ = items not counted, e.g. when bag with several items/clothes was discarded
Stored in block: F-41.2; H-12

Image-No	Total Amount	Household Item	Clothes /Textiles	Electronic Item			Condition						Reused			Placement	
				Screen/TV	Micro-wave	Other	Directly usable	Needs Cleaning	Needs repair /refurbishment	Only Parts usable	Recyclable	Not clear	Yes	No	not clear	In bin	In front of bin/ on street
F-7	2	1 Storage box	1 jacket				1	1							2		2
F-12	1	1 Basket						1							1		1
F-15.3	1	1 Bag of items from drugstore					1								1		1
F-20	1	1 Dish rack							1						1	1	
F-28.2	2++		2 Several clothes			1 Unknown device		1++				1		2++			2++
F-41.2	1			1			1						1				1*
F-43.1	1				1							1		1			1
F-46.1	1	1 Pan							1					1		1	
F-57.6	4	1 Dish rack, 1 chopping board, (more)	1 Blanket			1 Air condensator		3				1	3	1			4
F-58	1		1 towel					1						1		1	
F-63	1	1 pan							1					1		1	
F-75.1	1	1 bucket						1						1			1
H-1	2++		1 pair of Shoes, clothes					2++							2++		2++
H-2	1			1								1		1			1
H-3	1++		1 Bag of clothes					1						1		1	

H-4	**7++**	Glas, thermo coffee-cup, umbrella, Two baskets	1 Shirt, 1 textile				3	4++							7++		7++
H-5	**1++**		1 Bag of textiles					1++						1++		1++	
H-6	**2++**	1 basket	1 Bag of clothes				1	1++							2++		2++
H-7	**1**					1 Electric Heater						1			1		1
H-8	**2++**		2 Bags of clothes and textiles					2++							2++		2++
H-9	**2**					2 PCs						2 (wet)			2		2
H-10	**2**	2 baby bathtubs						2							2		2
H-11	**2++**	Broom + equipment	1 Bag of clothes					2++							2++		2++
H-12	**1**			1								1			1		1*
H-13	**1**			1								1			1		1
H-14	**1**				1							1			1		1
H-15	**1++**		1 Big Bag of clothes					1++							1++		1++
H-16	**1**					1 Vacuum cleaner						1		1		1	
H-17	**1**					1 Electric Heater						1			1		1
H-18	**1**		1 Pair of shoes					1							1		1
H-19	**2**					1 Sandwich maker; 1 heating plate for cooking						2			2		2
H-20	**1**					1 Vacuum cleaner						1			1		1
H-21	**2**					1 Sewing machine, 1 router						2			2		2
H-22	**3++**		1 Bag of textiles, 1 jeans, 1 textile bag					3++						3++		3++	
H-23	**6++**	Pot, bag of glasses, storage boxes				1 Blender, 1 Router, 1 unknown device		3++				3	4++		2		6++
H-24	**1++**	1 Mixed bag with						1++						1++		1++	

		household-items													
H-25	**1**			1							1 (wet)		1		1
H-26	**1**			1							1 (wet)	1			1
H-27	**1**	Cooling box					1						1		1
H-28	**1**				1						1		1		1
H-29	**1**	Storage box					1						1	1	
H-30	**1**					1 Small fridge	1				1 (me)				1
H-31	**1**	Ironing Board					1						1	1	
H-32	**1**					1 Iron					1		1	1	
H-33	**1**	broom					1						1		1
H-34	**5**		1 Backpack, 1 bag, 3 helmets				5				3		2		5
H-35	**1**	broom					1						1		1
H-36	**3**					1 water kettle, 1 Printer, 1 phone charger	3				3		3		3
H-37	**4**	Plunger, baskets (3)					4						4		4
H-38	**1**	Dish rack					1				1 (me)			1	
H-39	**1++**		1 Bag of textiles				1++						1++		1++
H-40	**1++**		1 Bag of textiles				1++					1++		1++	
H-41	**2++**		2 Bags of textiles				2++					2++		2++	
H-42	**1**					1 Unknown electronic device					1		1	1	
H-43	**1++**		1 Bag of textiles				1++					1++		1++	
H-44	**1++**	Bag with household-items					1++						1++		1++
H-45	**3**	dish rack,				2 blender,	1				2	3		3	
H-46	**12++**	1 Chopping board, 1 cooking tool, 2 buckets, 1 brush	3 Jackets, 1 trouser, other piece of clothes,			2 Router	10				2		12++		12++

ID															
H-47	**3++**	Smaller household-items	1 Pair of shoes, a few clothes,				1	3++						4++	4++
H-48	**2++**	Smaller household-items				1 Iron	1				1			2++	2++
H-49	**5**	2 bowls	1 textile			1 Water kettle, 1 other device		3			2		5		5	
H-50	**2**	Baking tray				1 toaster		1			1				2	2
H-51	**1**					1 heating plate					1				1	1
H-52	**1**					1 car-battery					1				1	1
H-53	**1**	1 plant					1								1	1
H-54	**1**	1 Yoga mat					1								1	1
H-55	**3++**	2 door mats	1 Bag of clothes				2	1++							3++	3++
H-56	**1++**		1 Bag of clothes + textiles					1++							1++	1++
H-57	**1**	household-item							1						1	1
H-58	**4**	Backing pan, other household-items	1 Pair of shoes			1 Sound system		3			1				4	4
H-59	**1**					Parts from vacuum cleaner				1					1	1
H-60	**3**	1 pair of sunglasses				2 phone chargers		1			2				3	3
H-61	**1**	Storage box						1							1	1
H-62	**1**		1 Pair of shoes					1				1				1
H-63	**1**	2 glasses						1							1	1
H-64	**3**	2 luggages, 1 vase					3					1		2		3
H-65	**2++**		1 Bag of clothes, 1 jacket					2				1		1++		2++
H-66	**1**			1						1 (wet)				1		1
H-67	**2++**	household-items	1 Pair of shoes					2++							2++	2++
H-68	**1**					1 Vacuum cleaner					1				1	1
H-69	**1**		1 Pair of shoes					1							1	1

ID	Amount	Household Item	Clothes /Textiles	Screen/TV	Micro-wave	Other	Directly usable	Needs Cleaning	Needs repair/refurbishment	Only Parts usable	Recyclable	Not clear	Yes	No/in bin	not clear	In bin	In front of bin/on street
H-70	**1**	Ironing Board						1					1			1	
H-71	**2**			1		1 PC						2	1		1		2
H-72	**1**	Vase						1							1		1
H-73	**1**		1 backpack				1						1				1
H-74	**-**	Box put at entrance for book to reuse										-					-
H-75	**2++**		1 Handbag, clothes				1	1++							2++		2++
H-76	**1**	1 Metal basket						1							1		1
H-77	**1**	Household-item for cats						1							1		1
H-78	**1**	Ironing Board						1						1			1
H-79	**1++**	2 books					1++						1++				1++
F-99.4	**2**		2 bedclothes					2						2			2
H-80	**1**		1 pair of shoes					1						1			1
H-81	**1**					1 Vacuum cleaner						1			1		1
H-82	**1**					1 fridge						1			1		1

Total Numbers

Amount	Household Item	Clothes /Textiles	Screen/TV	Micro-wave	Other	Directly usable	Needs Cleaning	Needs repair/refurbishment	Only Parts usable	Recyclable	Not clear	Yes	No/in bin	not clear	In bin	In front of bin/on street
166++	65	52	8	3	39	21	88	8	2	0	46	21	35	110	29	136
100,00%	~38.9%	~31.1%	~29.9%			~12.7%	~53.3%	~4.8%	~1.2%	0,00%	~27.9%	~12.7%	~21.2%	~66.7%	~17.6%	~82.4%

Notes:

F-41 – screen - stored inside dorm block - reused

F-80 – mentioned on Facebook to be reused

Appendix 10 - Observational Notes - DIK

Notes were made in chronological order without noting the date

<u>Notes (February – April 2020):</u>

> almost every day furniture is disposed in front of the buildings or near the waste-bins
> these are often several items/pieces of furniture - indicating that one whole furnished room has been emptied
> more often single items are put in front of the dorms: office-tables, coffee-tables, beds, chairs, office chairs,….
> some of the items are gone, e.g. when several items where placed outside, after a while some of the items disappear. Since this happens also on the weekends and not everything is gone, the furniture is less likely to be put into the trash bins/corners by the inspectors, but rather picked up by some tenants for use. This indicates the function of putting the furniture in front of the buildings as a trading place and furthermore the openness/willingness of some tenants to use 2nd hand furniture, even though they don't know the previous tenant.
> items that have been removed (supposedly been re-used by tenants) during the weekends (participating in market place concept): a shoe shelve, ottomann (foot rest), couch-table, office-desk

> never seen anybody yet putting out furniture or picking up some that was outside
> but I participated myself in that practice in the first year and now: coffee-table, office-table, another coffee-table (organic shaped), kitchen + office chair (twice)
> also furniture from the previous kitchens – chairs + tables – are mainly stored in the area with the fence around the bigger containers
> when it rains several items become less attractive/decrease in usability, e.g. furniture with upholstery that is not water resistant (soaks liquid in), laminated wood furniture
> the furniture is quickly away during the week, as the inspectors make their route to clean up relatively early – ca. 9:00
> waste that has been found in front of the bins the previous day/evening was often found the next day inside the bins, which were prepared for emptying by the inspectors
> also many normal trash-bins contain other objects: e.g. the metal-bins filled with blinds, other waste-bins filled bags of clothes
> other items put in front of the bins: bags with clothes, waste-bins, clothe hangers/racks,
> the furniture that seems to be considered trash are stored at two locations,
  – one small corner at the entrance closer to the train-station: this seems to contain mostly disposed furniture from the students: many beds + mattresses, chairs,
  – the fenced big containers, which can only be entered by the inspectors: this mostly contained old furniture from the kitchens like tables + chairs
> some of the furniture have been moved: e.g. chairs, or mattresses (thrown around maybe)
> most of the furniture seemed like they were in a pretty good condition when disposed on the street/ curbside – only a few seemed unusable: e.g. chairs/office chairs: missing a back-rest, back-rest uneven
> demolition - smaller degree: e.g. mattress thrown around (after it was outside for several days, clothes dryer/hanger (tubes) taken apart
> rain: clothes, pillows, artificial wood-boards becoming invaluable/unusable when exposed to rain → become waste

weekend 15/16.02.2020

> some person dropping several bags of "waste" next to one of the bins areas – it doesn't seem like he was a tenant at DIK (even though the local red-cross-store is ca. 400M away and clothes-donation containers are even closer
> later some of these bags were open and showing clothes inside

> a fridge was disposed directly into the trash-corner with the smaller fence (1.6m)
> it wasn't put in front of the dorms first, it wasn't disposed there by the inspectors, since they don't work on the weekends, the fridge appeared in a very good condition
> the fridge was on later photos not seen anymore – it supposedly was reused

> several bags of trash were disposed at one of the bin-areas along with two children plastic-bathtubs, I didn't look into the bags, but it can be assumed that they were also not just filled with household waste, but rather filled with household items, originating from someone moving out

> furniture that is standing in the hallways of the blocks get thrown out resp. destroyed even though it's still usable/in perfectly usable condition, by the inspectors, as it seems

> people dispose furniture, that appears as almost new and usable, in disassembled condition in front of the waste-bins and smaller parts into the waste-bins, these items in front of the waste-bins are then thrown into the fenced waste-containers or waste-corners – like two bed-frames and a shelve
> many chairs of one type were put into the waste-corner and to the waste-containers, presumably until it's picked up by the waste-managers, these were old chairs from the kitchen and were most likely put there by the inspectors
> the wood parts, e.g. table-boards from the old kitchen-tables, old shelves etc. seem to be disposed into one of the waste-containers at the fenced areas
> bulky-waste or furniture of mixed materials, e.g. the fridges, mattresses and beds, chairs, the metal-based from the old kitchen-tables are disposed at the small waste-corner (lower fence)

> someone disposed a **piano**, which was made in Denmark in front of the dorm, so it was exposed to rain for a little while already – it's not clear if it's still working or was just placed there temporarily; but if it was actually disposed there, this throw-away-mentality reached a new level
> later check showed it seems to fully work, all keys were giving a sound and it seems it was permanently disposed there, as it was still there on Saturday evening; instead of calling someone or organizing some kind of pick up, the easiest way of disposing was chosen, which will lead to at least a strong impact in the condition of the music instrument, until eventually someone picks it up or more likely it will be thrown to the waste-containers at some point
> a chat later with the inspectors (5 days after it was standing there), the inspectors told me, when I asked them, that the piano will be thrown away and they haven't done it yet because it's so heavy. The furniture is handled: "Clean and Silent" as Chresten explained it
> the piano was finally removed (by an unknown person) after ca 10 days – it was more and more falling apart and was opened by people so it degraded more

> drunken people from my block, which were playing superloud music and yelling around drunkenly seem to have taken one table from the common area, which was in perfect condition,
> parts of the table (foldable sides) can be found the next day in the yard of the block along with several remains of a party,

> Another chair that was there, which had previously just one leg uneven and needed slight repair, was now completely destroyed with the plastic rest broken (intentionally or unintentionally) beyond repair and is only usable for recycling – behavior and damaging functioning pieces of furniture also plays a role in the premature disposal/shortage of life-time of the products

> furniture gets placed in the halls or common areas: due to move out (several pieces) or just single items, that maybe thought to be stored there permanently
> furniture or other items (e.g. old TV-screen) stored there are disposed sooner or later by the inspectors, no matter if they work or not – e.g. a perfect conditioned wardrobe made from metal-pipes was destroyed and put into the metal-bin (block 8V)
> common area chairs are put outside – e.g. previous use but forgot to put in – new and old chairs -this uncertain condition can lead to disposal
> reasons for disposal from the inspectors therefore seem to be : unclear ownership and standing in areas where it's not allowed to stored furniture, next to the bins thrown out anyway

> large sofa from real leather has been put to the bins, the pillows were take to the side, therefore it was even more exposed to the rain and can now be considered waste, a few hours later (3-4) it was already done

> IKEA delivers furniture with small cars (or hangers that could be rented) for easier transport
> a mattress has been disposed in a disassembled condition: person cares about separating material for better recycling
> mattress can be designed for disassembly: upholstered parts could theoretically be cleaned

> direct observation how a person is disposing two blenders, that seemed optically in a good condition

Weekend with lot of discarding (14.03.2020) - at least three households

> on 14/03/20
> directly observed how a couple took a shelve from disposed furniture to their block
> proof that the practice of picking up curbside-waste/-furniture is taking place – resp. that use furniture is accepted without knowing the owner, but seems strongly dependent on type of furniture (e.g. everything that is cleanable)

> a truck of Remondis A/S is emptying the small metal bins – hence furniture at DIK is handled by three different companies: Vestforbraending; Remondis A/S; Marius Pedersen A/S
> unclear options where to put furniture for Inspectors, tenants (and at Genbrugsstation) lead to mixed waste streams: e.g. when mattresses are put into the waste-corner

> 25/03/2019 – several pieces of furniture have been disposed in front of block 1V; a bed without legs, a lamp, a shelve, a table from IKEA disassembled, but all pieces present;
> the lamp was shortly after gone, supposedly taken by somebody
> I personally took the shelve and cleaned it

> same day another desk shelve/trolley from wood was left at the bins near the entrance
> in the evening I directly observed a person pushing this pieces of furniture towards his

own block most likely for reuse – the practice of picking up curbside furniture was directly observed

> move-out disposal not necessarily more at the end of the month
> most move-outs on weekends – allow to observe if "pile" of furniture grows or decreases as indicator for practice of picking up curbside-waste

> a lamp (that I took previously) stored in one of the broom rooms, was part of a desk lamp, of which the lamp shade was broken from the main body – this allowed to identify it as an IKEA product – the design can be concluded as made to break, as the part that broke was made out of plastic and seems as an intentional build in design flaw

> one carpet that has been disposed by one of the guys I briefly interviewed (spontaneous) was later taken by somebody (weekend)

Tour through all dorm blocks:
> 29/03/2020 – 14:30-15:00
> looking for left furniture
> not too much
> many pieces of furniture left in common areas were hard to identify as furniture left from somebody for reuse or specifically bought from people of the block for the common area
> two spontaneous interviews held on that issue in common areas (normal conversations)
> One common area (8V/8O) was left with plenty of pieces of furniture, clothes household items and more (see photos)
> two days later, I visited the block again, and most of the furniture was gone, most likely reused, like a sleeping sofa, which already was used up on some spots, a chair pillow, a protector for the mattress, a shoe shelve and more (see comparison photos) – since other items were still left there, like a water kettle and clothes, it indicates that not the inspectors picked up these items
> a moment later I asked one of the young inspectors if they cleaned up this area yesterday and he said no (only last week)
> therefore the furniture was reused and the acceptance of taking used furniture with not knowing the previous owner was indicated; also items which could be hygienic problematic or not in the best condition were reused
> some of it was previously advertised on Facebook, but got no feedback; but later when it's left for free, it finds bigger acceptance; the biggest trigger seems to be money/price
> a sleeping sofa that was offered on Facebook was later seen standing in front of one of the blocks during the tour, next to plenty of other items

More Notes:

> a couch-table (IKEA) was disposed in the evening and was over night covered in snow and was already not in the best condition anymore – nonetheless, the table was gone next evening, presumably picked up by somebody

> quite a few people are moving by car or with small transporters to the dorm or from the dorm – moving with furniture is quite a common practice at the dorm – not clear if that is only Danes or international people

> the table that was left in my block from Abhi, was taken by two girls (01/04/2020) – was standing there for ca. 3 weeks

> picked up three cork pin-boards for the wall from a waste-bin, and put two of the them in the common area of my block
> a few hours later one was gone, a few days later the second one as well – most likely picked up for use by somebody
> storing inside the block gives the highest chances for reuse as it is stored dry and maybe gives less of a feeling the items being waste

> furniture or household items that were seen in front of the bins are found the next day inside the bins when the inspectors prepare the bins for emptying
> they disassemble small furniture and put it also into the household bins
> they only work during the weekdays from ca. 08-15:00

> a bag of clothes that was disposed in the evening, was gone by next day's afternoon

> 16/04/2020 – computer was disposed (found in the morning) – was picked by two guys living in the dorm (early evening) - directly observed

> 22/04/2020 – IKEA table (F-93) that was left in front of the waste-corner, was picked up and taken into the block by a neighbor of my block

> 28/04/2020: Me and other tenant disposed old pans into metal bin day before
> Have bin picked out of bin from people who are collecting waste privately in a white, used up van – they are not from the dorm or any official waste-management company

> the new Kitchen furniture (chairs) have been left outside by several parties (in my kitchen and others) which expose it to rain – also over longer periods – some chairs are standing outside for weeks
> those of my kitchen had also partly deformed legs, which I re-bended into it's orginal shape – people here don't treat common furniture with much care – furniture which you can so easily deform, doesn't indicate a quality product
> in another kitchen one of the new chairs had already legs that were loose

> someone from the dorm dispose a mattress/foams by throwing them over the fence of the container area (indirectly observed – have seen him walking to this area and a moment later it could be seen behind the fence)

> 26/05/2020 – someone is directly observed how he discards a shelve and luggage in front of the waste-bins

Appendix 11 - Unstructured Interviews with DIK Tenants

<u>Unstructured Interview 1</u>
Group of male tenants – ca 25 years old (06/03/2020)

Based on memory protocol

> a brief chat with one of several guys, who are moving out of one of the double rooms (opposite of my block) were disposing items: putting a carpet and a microwave next to the bins (F-31)
> I asked them if its from them, they said yes
> I asked them why they didn't put the items up for sale on Facebook:
> They said:
  – for the carpet it's too dirty and / or too expensive too clean, that's why they didn't offer it for sale
  – finally it was two carpets
  – one seems to be taken by somebody – picking up of curbside furniture
    (as it was placed there shortly before the weekend, when no inspectors work and was also not there anymore on Sunday), on Monday one of the carpets could be found in the waste-bin
> He said, they are trying it for the upholstered chairs and sofa.
  – two upholstered chairs and a sofa, as well as a table were posted few days later for sale on Facebook for 700 DKK (low price for a whole set of dining room furniture)
  – the items were of "antique" or "traditional" aesthetic
  – they weren't receiving any replies (after three days)
> For the microwave he didn't explain anything. He also said he is moving to Valby (if I understood it correctly), which is just a few km away. So the question why he is throwing furniture away, instead of moving it, isn't clear.

<u>Unstructured Interview 2</u>
Male Abhi (from Nepal) ca. 25 years old (09/03/2020)
Written Interview via. Facebook
He gave his consent to use this content for the thesis.

Tenant from the same block I live in.
Interviewed because I knew he is moving out and leaving some furniture and that he advertised furniture already on Facebook.

Exact Message
"*Igy no its okay*
Hy
Its okay
I sint sold my furniture i just give aways to those people who need them most
I gave away my sofa and other furniture
And the one thats there is for people who asked me to have that . I couldnt wait them to give so i had to leave there and asked them to take it as soon as possible from 1 ø
I like to help people so some people couldnt be able to pay for such things so i feel like to give for free
About facebook i think u r not that active ! Coz i posted it on dil and some of them took it aftwr that i deleted all posts ...
So these are reserved

Its goos that u asked
Gipds
Goods
Hppy to help in ur study
I dont have ego things so all are my friends so there is nothing that makes me not to reply
Thanks"

Central Statements (corrected):
> "*I didn't sell my furniture. I just give away to those people who need them most. I gave away my sofa and other furniture.*"
> "*And the one that's there (placed in the hallway of the dormitory block) is for people who asked me to have that. I couldn't wait them to give so i had to leave there and asked them to take it as soon as possible from 1 ø. So these are reserved*
I like to help people, so some people couldn't be able to pay for such things so i feel like to give for free."
> "*I posted it on DIK (Facebook) and some of them took it, after that i deleted all posts.*"

> he also explained that he was moving to Central Copenhagen, as he found a room there
> why he doesn't take his furniture with him remains unclear
other comment from same person:
> "*people throw away so much more furniture in the summer*"

Unstructured Interview 3
Male, ca 25 years old (14/03/2020)
Based on memory protocol

Someone want to dispose clothes and asks me where he could dispose the pullover. I am explaining him where he could find nearby Red-cross-containers.
He says it's bad that you don't have information where to dispose it for reuse and instead have to put it into the waste-bins.

Unstructured Interview 4
Male, ca 25 years old (14/03/2020)
Moving out of a double room
Documentation F-57 (largest amount of discarded items)

> a lot of different furniture is discarded in front of the bins from a double room
> I see directly how he is bringing out to leave it there.
> The handling is partly very uncaring as from a shelve one glass door was shattered with the pieces lying around
> I approached him and asked why he is moving out: "*I finished my study*"
> I asked: "*Why don't you put it on Facebook?*"
> couldn't really give a clear answer – he said: "*It's ok man.*"
> I didn't further asked as he seemed busy emptying his room – it seem that this is the quickest and easiest way to handle it, as putting it on Facebook would be more time-consuming – this has to be compared to the gained value: small income for items that have little financial value when resold

Unstructured Interview 5:
Karolis, male, ca 25 years old (20/03/2020)

Living at DIK since 3 years

Based on memory protocol

> "In the summer, when people move back to their home-countries, there is so much furniture-waste here, it's all the wall (ca. 200m) and at the waste-corner, there is so much, you can't even see the fence."

Unstructured Interview 6 & 7 - Tour through the dorm block's common areas
29/03/2020
Based on memory protocol

Unstructured Interview 6:
> male in his 20's
> he approached me if I am new in the block
> I explained him what I was doing
> he told me a story how he was picking up a table
 > "I was using the table the inspectors left in the common area, from someone who moved out and left the furniture in the room. It was standing there for two days and then I took it. I was using it because mine was too small, so I changed it and left mine in the area. It was standing there also for quite a while."

Unstructured Interview 7:
> male in his 20's
> approached me if I am from the blue kitchen
> I told him no and what I was doing
> he recommended me one furniture group on Facebook in Albertslund
> I told him that we have one Facebook group for the dorm where furniture is offered regularly – he didn't know about that group, nor was he member of it
> further I told him about Genbruggstation and that you can pick up furniture there for free
    –   he didn't know either, but thought it was interesting and useful
> I took photos of items in the common area – amongst one carpet
> He explained me that he left the carpet there so somebody could reuse it, which why he left it originally in arranged, tidy manner, so it doesn't appear as waste
> he then rearranges it by folding it
> he left it there since it doesn't match his aesthetic expectations anymore
> he took it from his mothers house when he moved out, but still disposed it because of aesthetic – it didn't seem to have too much emotional value
> he sees furniture waste also as a problem

Unstructured Interview 8:
Female, ca. 20 years old
Based on memory protocol

> ask her she took/used the desk, left by a previous tenant (Abhi) in the block (three weeks prior)
> Yes, because she needed it
> she also wanted to take an office chair that left there, but didn't take first and then someone else took it
> the unclear ownership status hinders the reuse of furniture, it requires communication to state it can be reused/is donated

Appendix 12 - DIK Facebook Group Analysis Charts

Overall Content - Last 300 posts
25.04.2020 – 17:00

<table>
<tr><td colspan="16">Chart A12.1: Overview Topics Posts (last 300) Facebook Group DIK Albertslund
(https://www.facebook.com/groups/465418806863873/?ref=group_header accessed and counted 25.04.2020 – 17:00)</td></tr>
<tr><td colspan="7">Trade/Marketplace</td><td colspan="9">Other Topics</td></tr>
<tr><td>Furniture -Offer</td><td>Furniture Request</td><td>Household-Item Offer</td><td>Household-Items Request</td><td>Other items Offer</td><td>Other items Request</td><td>Lending/ Borrowing/Sharing Item</td><td>Key/Locks/Doors</td><td>Something Doesn't work in dorm</td><td>Social Issues/ Complaints</td><td>Social Event</td><td>Subrenting / Renting</td><td>Other Information Requested / provided</td><td>Official Information from DIK / Information Requested Living at DIK</td><td>Others</td></tr>
<tr><td>xxxxxxxx xxxxxxxx xxxxxxxx xxxxx</td><td>xxxxxxxx</td><td>xxxxxxxx xxxxx</td><td>xxxxxx</td><td>xxxxxxxx xxxxxxxx xxxxx</td><td>xxxxxxxx xxxxxxx</td><td>xxxxxxxx xxxxxxxx xxxxxxxx xxxxxx</td><td>xxxxxx</td><td>xxxxxxx xxxxxxx xxxxxxx xxxx</td><td>xxxxxxx xxxxxxx</td><td>xxxxx x</td><td>xxxxxxxx</td><td>xxxxxxxxxx xxxxxxxxxx xxxxxxxxxx xxx</td><td>xxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxx xxxxxxxxxxx</td><td>xxxxxxx xxxxxxx xxxxxxx xxxxxxx xx</td></tr>
<tr><td colspan="16">Total numbers: Absolute & Percent (300 posts)</td></tr>
<tr><td>29</td><td>8</td><td>13</td><td>6</td><td>21</td><td>15</td><td>30</td><td>6</td><td>25</td><td>14</td><td>6</td><td>8</td><td>33</td><td>56</td><td>30</td></tr>
<tr><td>9.7%</td><td>2.7%</td><td>4.3%</td><td>2.0%</td><td>7.0%</td><td>5.0%</td><td>10.0%</td><td>2.0%</td><td>8.3%</td><td>4.7%</td><td>2.0%</td><td>2.7%</td><td>11.0%</td><td>18.7%</td><td>10.0%</td></tr>
</table>

<table>
<tr><td colspan="16">Chart A12.2: Analysis of Facebook Group DIK Albertslund – Furniture Trade (Created by author)</td></tr>
<tr><td rowspan="2">Image #</td><td colspan="5">Type of Request</td><td colspan="9">Type of Item</td><td rowspan="2">Responses</td></tr>
<tr><td>Want to Sell</td><td>Want to buy</td><td>Want to give away</td><td>Disposal Question</td><td>Other</td><td>Furniture in general</td><td>Sofa</td><td>Bed/ Mattress</td><td>Lamp</td><td>Chair/ Seat</td><td>Shelve</td><td>Desk/ Table</td><td>Others Furniture</td><td>Other Household Items</td></tr>
<tr><td>1</td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td>x</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td></tr>
<tr><td>6</td><td></td><td>X</td><td></td><td></td><td></td><td>x</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>13</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td>x</td><td></td><td></td><td></td><td></td><td></td><td></td><td>/</td></tr>
<tr><td>33</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td>x</td><td></td><td>x</td><td></td><td></td><td>8</td></tr>
<tr><td>35</td><td></td><td></td><td></td><td></td><td>X</td><td>x</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>8</td></tr>
</table>

	C1	C2	C3	C4
36		X		
39			X	
46		X		
47		X		
48			X	
49		x		
50		X		
51	X			
53		X		
54		X		X
55				
56			X	
57		X		
58		X		
59	X			
60	X			
61	X			
62		X		
63	X			
64	X			
65	X			
66		X		
67		X		
68	X			
70	X			
71	X			
72	X			
74	X			

C1	C2	C3	C4	C5	C6	C7	C8	C9	Value
		x							4
							x		4
		x							2
					x				3
x							x		8
x									0
X									1
	X								2
				X					0
		X		X	X				4
								X	2
	X								2
						X			0
					X				0
				X	X				1
	X		X						3
				X					1
		X							2
			X		X				2
		X			X	X			5
		X			X				2
			X						0
					X				0
					X				0
					X		X		0
		X					X		0
	X		X						1
							X		0

#													N
75			X			X							1
76	X							X					1
78		X				X							2
80	X						X		X				4
82	X								X				1
83	X								X				0
85	X											X	0
88	X								X				1
89	X					X							2
90	X							X	X	X			1
91	X							X	X				1
92	X						X					X	3
93	X					X						X	3
94	X		X				X		X				1
95	X				X								1
96			X			X							2
97	X						X	X					1
98	X		X		X			X	X	X			2
99	X				X								3
100			X						X			X	0
101	x					x			x				2
102		X		X									2
104	X							X					0
105			X			X							1
106	X		X					X				X	0
108	X					X							0
109	X						X						1
110			X	X									2

Left table:

#				
111	X			
112	X			
114			X	
115	X			
118			X	
119			X	
120	X			
121	X			
122	X			
123	X			
124			X	
126	X			
127			X	
128	X			
130		X		
131	X			
132	X		X	
133	X			
135	X			
136	X			
137/138	X			
139	X			
140		X		
141	X			
142	X			
143	X			
145	X			

Right table:

c1	c2	c3	c4	c5	c6	c7	c8	c9	value
X									0
X									1
					X			X	3
			X					X	2
	X				X				1
								X	1
X									1
		X							1
		X							0
								X	0
						X			2
		x		X		x			2
		X							1
		X							0
	X								4
		X							3
		X	X			X			4
		X							1
		x	x	x	x	x	x		9
	X								1
		X							3
	X								2
						X			1
					X				2
					X				1
		X							1
						X			0

Left table:

146	X			
148		X		
149	X			
150	X			
151	X			
153	X			
154	X			
155				X
156			X	
157			x	
158	x			
160	x			
161	x			
163	x			
164	x			
165			x	
166	x			
167			x	
169		x		
171	x			
174	x			
176	x			
177	x			
179	x			
180		x		
181	x		x	
182	x			
183	x			

Right table:

			X				X	1
		X						1
			X					1
X								0
				X				1
			X					0
	X							1
								0
							X	4
							x	1
							x	0
						x		2
						x		0
X			X		X			0
				X				1
x								1
			x					1
						x		2
			x					2
			x		x	x		1
		x				x		1
	x							3
				x				1
			x		x	x		1
			x					3
		x	x		x			2
			x				x	0
x								0

ID	Want to Sell	Want to buy	Want to give away	Disposal Question	Other	Furniture in general	Sofa	Bed/ Mattress	Lamp	Chair/ Seat	Shelve	Desk/ Table	Others Furniture	Other Household Items	
184			x					x							0
185			x								x				1
188	x									x				x	0
189	x											x			0
190		x						x							0
191	x								x					x	4
192	x												x		1
194	x									x					1
195	x												x		1
196	x							x							0
197	x						x								1
198			x											x	0
199		x										x			0
201		x								x					2
202				x		x									2
203	x									x					1
204	x							x	x	x					3
206		x									x		x		0
207	x								x						0
208	x							x							0
209	x											x			1
210			x					x							1

Summary/ Total numbers: Absolute & Percent															
Amount	Want to Sell	Want to buy	Want to give away	Disposal Question	Other	Furniture in general	Sofa	Bed/ Mattress	Lamp	Chair/ Seat	Shelve	Desk/ Table	Others Furniture	Other Household Items	
139	87	24	26	4	2	11	16	37	13	23	24	32	16	20	
%	~60.8%	~14.6%	~15.9%	~2.4%	~1.2%	~5.7%	~8.3%	~19.3%	~6.8%	~12.0%	~12.5%	~16.7%	~8.3%	~10.4%	

Appendix 13 - Agenda Center Albertslund Interview

Date: 12/03/2020
Place: Agenda Center Albertslund
Interviewee: Signe Landon, Sustainability consultant at Agenda Center Albertslund
Interview duration: ca. 60 min.

The interview with the Agenda-Center was hold in behalves of Albertslund Municipality as they redirected me to the Agenda Center.
Subsequently we drove to the nearby Albertslund Genbrugsstation to continue my previous interview with them. Signe Landon suggested this as she offered her help to translate the Danish of the employees. This part is included in the respective interview in Appendix 14.

>   Interviewer Tobias

Interviewee Signe

Central Statements:

>   Why was the task with giving me an interview outsourced to you?

I am not sure, I think Birte Kvamm has too much to do.

>   You are not officially in place to take care of this (waste-issues), are you?
>   1) What kind of organization is Albertslund Agenda-Center?
>   - governmental, private or something else
>   2) What are your tasks here in Alberstlund?

No. But we work as consultants for the municipality and we have been doing it a lot when it comes to garbage. We work close with them.
We are a local NGO, we work with everything that concerns the environment. We help people that live in Alberstlund, like right now teaching kids how to sort garbage.
[mentions several projects about societal education on environmental questions.]
We planted a thousand trees in Alberstlund. We do all kinds of different things with consultancy and the environment. Like our own thing and sometimes we are helping the municipality. We are not governmental or private, we are somewhere in between.

[about the Genbrugsstation]:

As far as I know, when you come down there,[to the Genbrugsstation], as a private person, you decide yourself if you want to put the furniture in that room [Møbler storage room]. But sometimes I see the people [working] there, if they see somebody go to the container, they say: "Oh, isn't that too good to throw-out? We have this room where you could place it.".
But it's still up to the person, who throws the furniture out,if they want to donate for reuse or if they will put it into the containers. But they get the advice from the people working at the station, if they are there and not someplace else on the station.
Sometimes they take things out of the containers and bring it to the reuse like the storage room or Draehusn.
They have their eyes open and see if something is usable. I think the people who work there do a good job to get as much recycled or reused as possible.

3) Why is furniture-waste not measured separately?

I just asked Birte, from the municipality, and she said they don't have any numbers. I can't answer that, but I guess they want to make it as easy for the people to put and take furniture there (the storage room).

And how about the waste-containers?

She said, because furniture is part of what's called "Storskrald" (bulky-waste) and they don't measure that. She said, they sort it and most of it goes into [the waste-fraction] "Træ", yeah, but not all of it.
[The field trip to the Genbrugsstation revealed this is not the main waste-stream for furniture.]

But furniture is not just Træ (wood), it's also metal and everything else?

And that's why she said, furniture doesn't have a part on it's own. Because it's part of Storskrald and then also Træ, sorted into different things.
But she said most furnitures will be considered as Træ.
(the subsequent trip to the Genbruggstation showed it's not mainly put in there.)

But you can also say: Træ is not only furnitures, it's also people who come in with other things. So you can't say, this number (on Træ) is only furniture. If you tear down a ceiling (wood bars), it would also be Træ, even though it's not furniture.
But it's also hard to work with this number, as they have been changing the way how to measure it, like indoor wood and outdoor wood is now in this category.
So this number is on Træ is not reliable.
I think Vestforbraending is the ones to talk to, since this number, you can't use it for much.

How do you explain this number here. [Graphic on Genbruggstation from waste-report p. 4]?

It went up, we throw more out.

Also per capita?

Yes, no. It's hard to say. The thing is , in Vestverbranding's area, in 2018, some of the other municipality's Genbruggstations were closed and then Albertslund it could have an increase in waste since from other municipalities the waste left there.
So it's really hard to make anything out of it.
It's always just in general [not measured waste per capita].
But this statistic [Graphic on Household-waste handling from waste-report p. 4] says the recycling part has increased and the stuff we burn decreased a little bit.

Does this statistic also include furniture?

Yes, it also includes furniture, because Trae are in that.
[The field trip to the Genbrugsstation revealed this is not the main waste-stream for furniture.]

I have heard very mixed stories how much is recycled and burned for furniture?

I can't give you the number either, because I don't know. It's the people from Genbruggstation and Vestverbranding that have an idea.

Do you think furniture-waste is a big problem in Alberstlund?

I think it could be bigger. In Alberstlund, people don't have that much money, and then I think you take care of your things more and keep them longer.
And then you try to sell your stuff, if it's worth anything. I think when people are more wealthy, the problem with furniture-waste is even bigger there.
But of course it's a problem, because a lot could be reused and not thrown-out, because people are little bit lazy. What's the easiest way to get rid of it? Throw it into the container. And students, in Denmark are considered being one the poorest group in Denmark and they are throwing things out. [pointing to the photos from furniture-waste of the dormitory.] And they don't have any car, so they can't get to the Genbruggstation.

Some other living areas have a Genbruggstation with a roof where you can put stuff, so it won't get damaged if you put it there for short period. And that would be a good idea at DIK, since it would be great if you could get items you need there for free, like a micro-wave.

4) Are there any shops that sells used furniture in Albertslund?

No. There are a lot of Facebook groups for sell and giving away furniture. It started as a page, where people help each other, taking care of people with little money. And often there are furniture there, like if anybody can use it.
[writes down the name of the page: Næstehjælperne Albertslund]
It's all for free: shelves, clothes,
It's a page made for helping people and they also use DBA for selling used stuff.
Facebook is quite used and accepted in society for selling or giving away furniture.

In our place we had a shelve for small things, outside here, but we had to take it down. But people also put furniture there, which was not the plan.

So, if DIK wants to make this (a storage room), they need to have man-power to clean it up and put it away, because somebody will be use it to dispose broken stuff.

And one example from DBA is, that someone was offering a very expensive, but used bed and they couldn't sell it. Because nobody want to buy a used beds, even though, nowadays we all use the protections on top of the mattresses. Nobody has actually lying on the mattress, but it's not sell-able.

But would you buy a used bed?

If the people I buy it from look like normal people, I could do it.

So you need to have a certain trust-basis to buy this (a bed)?

Yeah. And me, I wouldn't probably do it, if I wouldn't have been able to see the people on DBA. But if it's somebody I knew or somebody that knew them, then it could work.

5) How is furniture-waste handled in Albertslund Municipality?

In some living areas you can put out your bulk-waste in front of your garden and then the garbage people come and pick it up. All kinds of waste, not just furniture, it's then sorted by Vestforbraending.
There are two ways: either put it in front of your house or go to Genbruggstation.

And Albertslund Genbrugsstation is mostly there to sort waste, I guess?

Yes. But when you put the furniture in front of your garden (for pick-up), none of it will be reused, then it's thrown-out. It's better to go to the Genbruggstation if you want the furniture want to be reused.
You can't have these storage solutions, like at Genbruggstation, in privately owned houses, because you don't have anybody to do that kind of (maintenance and storing) work.

7) What happens to furniture that can't be brought into reuse?

They sort it and recycle or burn it. Metal will become new metal.

9) Who/which company is responsible for the waste-handling for furniture?

Genbrugsstation and Vestforbraending

11) What kind of initiatives has Albertslund Municipality started or implemented to avoid furniture-waste in general (not related to the DIK)?

It is for example this place for storing furniture. Before they had a smaller room, so they made it bigger. And also another room for building materials. They enhance the space for it.
And the online platforms? Like DBA

They were not initiated by the municipality. DBA is a private company.

12) What is the position of Albertslund Municipality towards furniture-waste resp. it's avoidance?

As they (Albertslund Municipality) say they want to be green and they are trying to, I don't think they have any ideas what to do. If you came up with any ideas how to do it better, I think they would be open to consider if anything would be possible. They want to.
The municipality wants to be as green as possible, but of course it also has to do with what's affordable to do. But there are good intentions, they do it as good as they can.

And what's this organization called "Gate21"?

It's a cooperation between the municipality, the state (government), the universities and private companies. It's cooperation between different initiatives trying to make different environmental solutions working together, using the knowledge of the different actors. Sometimes they work on projects with garbage, and other things. But I don't if they have something with garbage at the moment. They are there since 5 years or so.

How long are you active with the Agenda-Center?

Oh, maybe since 24 years.

We suggested this with the 500 trees being planted and then the municipality said, we are going to support this idea. When we come up with something, even though it might sound a little crazy, then we are getting support.
Like, Alberstlund Municipality is the municipality with the lowest water consumption in Denmark, because we put a lot of effort in it and were supported from the municipality.

     How did you do it?

We rang at the doorbells in the whole city and were giving out devices that help to save water for the tap, giving out brochures and making home-visits to people with high water-bills and giving advices how to reduce it in their daily live.
We put a lot of effort in talking to people and just throwing things in the mailbox, because people not often read that.

But it can also be the other way around, that they (Alberstlund Municipality) come up with an idea and we support them.

     13) Are there any shops that sells used furniture?
     If not why is that so? Because if there would be one in the center, this could already
     be a solution.

I think the rents in the center are way too high. You can't make enough money to pay the rent and the salaries. And you also need a lot of space to sell furniture and space costs money. It's privately owned.
But I think in these kind of (second-hand) furniture-shops it's more the style for old people and not for young people. Young people go on DBA or the internet to see if there is anything for them. They don't need shops like this.

     15) Would it be possible to implement some kind of publicly available storage rooms
     for furniture that allow to place and take furniture?
     Are the legislative boundaries to implement such a solution at the dorm, like
     containers?

I think it's possible. But at some point a lot of garbage would be put in there, that they need to handle.

     Would there be a legislational problem to do that?

No. I know it, because a lot of living areas has that, storage for things people think are reusable.
But you need to have somebody, a person, who is spending man-hours there, sometimes to clean up. But also man-hours are put into the disposal of furniture, it's probably not that much bigger.

Consent on using the name and interview via Email (29.04.2020):

Hello Tobias,
It is fine that you use my name and where I work.
Kind regards Signe

Appendix 14 - Interview & Field Trips Notes Albertslund Genbrugsstation

In total, Albertslund Genbrugsstation was visited three times during the research.

Field Trip - Observation Notes
Date 07.02.2020
Place: Albertslund Genbrugsstation

> distance from the dorm: ca. 2 km; reachable by bike
> entrance is designed for cars to enter, bike-holders not present
> many different containers
> container with plastic garden furniture: many pieces seemed quite usable – not broken
> (at least) two different for furniture: Havemøbler af plast (plastic garden furniture); Polstrede møbler Linoleum (Upholstered furniture Linoleum)
> møbler & BYT ET BRÆT: two rooms for storage of materials and furniture – seems for free pick-up
> glass-house: for selling old household items – conversation with employee Mirko
> open for interview, when I asked him
> statement from him: "*We try to re-use as much as possible.*"
> Re-use concept also for books – storage container with shelves
> said they are in contact with municipality – recommended to contact employee: Birte Kvamm
> Flyer from Agendacenter Alberstlund at desk
> Gate21 website [sustainability consultancy] was showing BYT ET BRÆT as development from them and municipality

Interview 1:
Date 05.03.2020
Place: Albertslund Genbrugsstation
Interviewee: Mirko
Employee working for Genbrugsstation, responsible for the cleaning, sorting and storage of household-items people bring there, into shelves and tables.

The conversation's key-statements are presented instead of the whole interview, as it contained many irrelevant information as this employee turned out to be not responsible for handling furniture-waste at Genbrugssation.

	Interviewer: Tobias
Interviewee: Mirko

Key-Statements:

With furniture, you mean big stuff? here [in the small house on the area of Genbrugsstation] we only have small stuff, not big stuff. Outside they have the big stuff, like furniture. The other guys know more about furniture. Normally they throw everything out. For the big stuff [furniture] I say (to the people bringing furniture here) either put it over there (the furniture storage room).
We just have small stuff [household-items] here [in the building he is responsible for].
[...]
Birte Kvamm Birte Kvamm [Environmental Officer at Albertslund Municipality], she is the

expert, she knows everything.

How is the procedure as a private person when you bring your furniture here? Which options do you have when you bring it here?

You have the option to throw them out or to put them in the big barn (storage room for furniture).

And the people decide it themselves where to put it?

They ask where to put and then I say, you should put it there or there, møbler room [Direct Reuse for Furniture] or containers.
You have to talk to the other guys for the other questions, they are the specialists.
Furniture is the big stuff, with a lot of wood that you can reuse, in here it's just small stuff. The problem is, they [the people responsible for handling the furniture-waste] know not exactly how much they throw out. It's actually Birte Kvamm and her Agenda Center, they know more about this and Povl Markussen, but they don't know what is happening here, he just know the big lines [picture].

What happens to the stuff that is thrown into the containers?

Yes, it gets reused. That's why you should talk to Vestforbrænding and Birte Kvamm, they have they percentages of how much is reused and everything.
Birte Kvamm is really burning for this. I don't burn for this, for me it's just a job. It's good to reuse, but it's just a job, for her [Birte Kvamm], it's kind of a passion. The Agenda Center, they are really burning for this stuff, there are two people Povl and Signe.
Plastic, you know, I think it's a good thing to burn plastic, because plastic is oil. Of course it's a problem, because then you have to make new plastic all the time. But in Denmark, we don't throw plastic on the street, we burn it and then it's ok. Plastic is a problem in the foreign countries.
[…]

Do you know if that is the case also for furniture?

A lot of it would be burned.

A lot of it would be burned?

Yeah. But again, I don't know the percentages, it's Vestforbrænding, who know about this.

But when furniture is thrown into the containers, it's definitely burned?

No not all the time. It's a bit of a problem, because you talk about furniture, it's not my specialty at all. But Vestforbraending, they know exactly how much get's reused.

What is the function and intention of the storage room for the furniture?

The function is to reuse the things, everything is free. And next to this room, there is another room for building materials, it has the same function. You put something there and you can take something.

The problem is we are working low practice. We are sending all the woods to

Vestforbraending, they will tell you how much they reuse and how much they burn, but Birte should know it too.
Ahmet is the specialist [at Albertslund Genbruggsation], but his English is not very good, Annette she knows it.
But Birte is the expert, its should be her you should talk to.

In this commune everything is floating, they have a lot of good ideas, but nothing ever happens. In Albertslund, their experts starting things up and then it just fizzles out. So you get cynical working in this commune. But the Agenda Center, and Signe, she is really good, passionate about it, and Povl, they do a good job down there.
Birte would call me and maybe she has some good ideas, she always has these good ideas. Sometimes I am a little tired and I am just working here. Birte has a lot of good stuff, but when it gets to the real world, things start to fizzle out. That's typical Albertslund, we are very famous for our green agenda, but in the end...hmm. […]

We do a lot with our waste, people sort it at home, we do what we can.

> You actually have several containers for furniture, don't you?

Yes, one for indoor wood and one for outdoor wood and then one for the mixed stuff, actually they are burning this. If I had the time, for plastic, I would sort it, but I don't have the time and then everything gets into burning, it's a questions of man-hours.

Interview 2 – Key-Statements:
Date 12.03.2020
Place Office of Albertslund Genbruggsation

Interviewee: female employee of Genbrugsstation (speaks only Danish)
Translation done by Signe Landon (Albertslund Agenda-Center)

The second interview was held unprepared, but was based on questions from the previous interview, as it was a spontaneous field trip since Signe Landon offered her help translate and enable the communication between researcher and the employees at Genbrugsstation, who mostly don't speak English very well.

> Interviewer: Tobias
Interviewee: female employee

Key-Statements:

A lot of the things that are put over there (storage room) with the furniture, are things that they are throwing-out afterwards, because a lot of things is kind of garbage.
It's easier [for the employees] to put it there and then throw it out.
So a lot of it is not useful [in the storage room], half of it. [she guesses.]

> What kind of fractions do you have for furniture?

Three: Clean, Wood and metal.
[Three fractions for indoor furniture: #1 metal; #50 Umalet Indendørstræer (Unpainted Indoor-wood); # 40 Polstrede Møbler Lineoleum – for upholstered furniture; one for outdoor furniture: #24 Havemøbler af Plast (Plastic Garden-furniture)]

But furniture is mixed material. How is it decided what goes where?

It's decided what's most here [included], is it wood, is it metal. For instance, if there is a table with a metal base and a wood-board, than they would put it in metal.

[Me pointing to an office chair made from upholstery, various plastics and a metal base.] Where would you put that?

Metal, because it's mostly metal. It's decided by what's mostly included.

What about upholstered furniture?

Sofas, mattresses, armchairs....

In the weekends more people come here and bring furniture, for instance families, when a family members has died, they are taking all of the furniture in there (the storage room). It's very different on these days.
So half of the furniture that is put into the storage room is reused and half of it is thrown into the containers for recycling.

Which kind of furniture is mostly thrown away?

Elevator Beds, bed-frames, not the mattress
If people bring here a couch, some people come and cut off the leather and leave the rest here, so only take parts of it.

You can't measure the waste coming in here, can you?

No. It can be in metal, it can be in wood and it can be in upholstered furniture. Most of the things in the wood container are not furniture, so it's hard to say.
[Pointing towards a chair mostly from wood with small upholstery on the seat.]
That would go to upholstered furniture.
And then sometimes, we [the employees] take it off [separate materials] and put it into two different places [fractions].

Do you also deliver or pick-up furniture?

No.

Who decides where to put the furniture: in the waste-containers or the storage-room?

[Signe Landon translates by describing what the employee said]:

It is the people [who bring their furniture to the Genbrugsstation] themselves who decide it. And then, when people who come here, put their stuff into the storage room, then the people who work here [employees] clean up. But the employees always try to put something that's still usable and looks nice out of the [waste] containers and into the reuse room. [Møbler room]
But sometimes customers don't want it to go over there [Møbler room] and then they [the employees] have to accept that, because that's their decision.

They ask the people, that they can go over there [Møbler room] and if they say no, it's the customers who decide. It is often for sentimental reasons.

And then there are also people who take furniture from the storage-room and re-sell it. And the customers don't want it to be given to those people, so they want it to be thrown-out.
The people who work here are sometimes, because of that, a little frustrated because the idea is not to sell it further, but give it for free. And if you need something, you should come and get it. But still it gets recycled, it's still good and bad that somebody takes it and sells it. They are coming three or four times a week to look for furniture, some of them come from countries that are less wealthy than Denmark. They sell it then to other countries, because Denmark has so much.
It's frustrating and not the idea, but you can't do anything about it.

Notes:
> Looking into the three containers, only the upholstered furniture container was purely used for furniture, the metal and wood container were also containing furniture, but not majorly or in a mixed condition.

Appendix 15 - Interview Red-Cross Store Employee

Date: 06/03/2020 – ca. 12:00
Place: Red-Cross-Store Albertslund
Interviewee: Birte D., female, pensioner and volunteer working at Red-Cross-Store Albertslund
The interviewee's mother tongue is Danish and rather limited in expressing herself in English.

> Questions interviewer (Tobias)
Answers interviewee (Birte)

Interview Transcription:

> 1) Do you sell any furniture?

No

> 2) If not why?

We don't have enough space.

> 3) Do you have the storage capacity to store furniture?

No

> 4) Would you sell furniture if you have the storage capacity?

Maybe.

> Due to hygienic concerns or work capacity?

Yeah. But I think it's the [was trying to describe it, but later elaborated] it's that we are mostly old people working here, voluntarily.

> 5) What happened to the old Red-Cross-Store? Could that be an option to store and sell furniture?

We got some water from upstairs, so the floor was damaged.

> But it was never the idea to have both shops?

No, no. And we are moving back into the old one [when the damage is repaired].

> 6) How do you advertise your store? / Do you advertise your store?

Yes, a little bit on Facebook.
And we have a deal with our local newspaper, Alberstlund Posten (weekly paper).

> We don't get that in the dorm?

You can find it at the library.

[note: They also have an own website just for this store.]

But I think you should really advertise in our dorm, because there are a lot of household-items and clothes thrown away. Maybe you could advertise your store in our blocks, where we have boards, where note-sheets could be put up. I think that would help already. This is also a huge capacity financially, as many sellable items are thrown out.

I can talk to my boss, Charlotte [store manager Charlotte Ginting].
The advertisement in the Alberstlund Posten is not included every week, I don't know the agreement, but at events like Easter or on sales.

7) Do you advertise your store at the nearby dorm DIK?
   Because a lot of household-items and clothing and other textile products are disposed there.

No, not that I know.

8) How is it handled in other Red-Cross-Stores with furniture?

This question is difficult for me to answer. For this you should talk to the chairman, Ayhan Can.

9) Do you know other Second-hand stores nearby where you can buy furniture?
   [Looks for some addresses noted down on a desk.]

There is this one (Red-Cross-Store) in Taastrup, only one station away with the S-train. They have furniture and the one in Ishøj (ca. 6 km distance – air). In Ishøj, you can call them and then they pick it up, when you want to dispose something. I don't know if they do it in Taastrup as well. In Taastrup it's bigger, they have three departments, two of those and one for furniture.

Further comments from interviewee:

Maybe it's because most of us are not young anymore, old and not all have Facebook and all that. Maybe younger people will use the internet more.

Do you mean with old people: Live here or work here?

Work here. I like and we do it voluntarily, no money. We are all volunteers, also the chairman. Only in the headquarter they get some money.
The job is also good, because you get some social life, you get something to do when you're not working.
My brother is also working in a furniture store in Jutland. And the furniture, it's heavy, you have to lift it. But firstly space is the most important aspect.

Appendix 16 - Correspondence with Waste-Managers

Correspondence Vestforbrænding

Overall Description of Contact based on memory protocol:

Two Emails were send to Vestforbrænding's general email address without getting any response. Consequently the hotline was called, which redirected the author to one responsible staff.
During a first phone call the staff's first reaction to the research topic was that Vestforbrænding is not responsible to handle this topic and that the author should look into waste-reports and contact the municipality. After explaining that all previous research lead to this stakeholder and insisting on getting answers, the staff agreed to answer the research questions via email.
These were send, on which the staff responded to not have time to answer the request. A second email was send with less questions (6) and asking for redirection to any other responsible staff that could have time. This was left unaswered.

Interview Request to Vestforbrænding 14.04.2020

Dear Kenneth S.,

my name is Tobias Hauptmann and I am writing you as I am in need of information from you for my Master Thesis research of Sustainable Design at Aalborg University, as already explained on the phone.
The thesis investigates *Furniture Waste in Dormitory Environments*, for which I research this topic in general and by means of the case-study Danmarks Internationale Kollegium (DIK) in Albertslund.

During this research I was redirected to your company by several people I talked to, as you are responsible for the waste-management in Albertslund and for DIK. Such as the inspectors working at DIK (Chresten Nielsen), due to a waste-report of the municipality you produce (AFFALD FRA HUSHOLDNINGER 2018 Albertslund Kommune) and by people working at Albertslund Genbruggstation.

Hence I have a few research-questions on the waste-handling you do for furniture, that are necessary for the completion of my research. These are:

on DIK:
1) Are you responsible for the waste-management of DIK for furniture-waste?
2) If so, do you have any statistics on the furniture-waste you pick up at DIK?
   - e.g. tons/m3/containers per year
3) How do you handle this waste-stream?
4) How much is recycled and how much is incinerated?
5) How does the recycling process for furniture look like?
   Furniture seems like a complicated waste-stream, that is according to my research often incinerated and mixed waste-streams are often downcycled into a material of lower quality.
6) Which kinds of materials in furniture and to which percentage can you actually recycle (keep resource value), is downcylced (into lower quality resource) and is incinerated?

Genbruggstation:

When I was at Genbruggstation, I have seen that there are three fractions for the separation of indoor furniture: *#1 metal; #50 Umalet Indendørstræer (Unpainted Indoor-wood); # 40 Polstrede Møbler Lineoleum.*

Together with an employee of Albertslund Agenda Center, I also went through the annual waste-report of Albertslund (AFFALD FRA HUSHOLDNINGER 2018 Albertslund Kommune) you produce, where we couldn't find any statistic on furniture-waste. I was also told it is not measured, by Birte Kvamm of Albertslund Municipality.

1) Do you measure the furniture-waste (three different streams of Albertslund Genbruggstation) anyhow? / Do you have statistics on the annual waste on these streams?
2) If so, how many tons/m3/containers of furniture waste are generated per year in Alberstlund Municipality?
3) If not, why don't you measure it?
4) What happens to the three different waste-streams?
5) How much of these (still mixed waste-streams) are recycled, downcycled and incinerated?

It would be great if you find the time to answer them by email, as a current meeting wouldn't be possible under these circumstances, I guess.

I am looking forward for a response.
Thank you, kind regards and stay healthy.

Tobias Hauptmann
Research Student Aalborg University
Sustainable Design Msc. Eng.

Email Answer from Vestforbrænding 15.04.2020

Hi Tobias,

Thanks for your interest in the waste industry

however, your questions require too much work for us to help you.

You may seek information from EPA and dst.dk
maybe you can use the FRIDA report as well as Denmark without waste

good luck with your project

Best regards
Kenneth S.

2nd Interview Request to Vestforbrænding 15.04.2020

Dear Kenneth S.,

one last time I request you or Vestforbrænding to answer my questions regarding furniture-waste as part of my Master Thesis research. It's six questions included in the email.
If you don't have the time please redirect me to a colleague who might has to provide these important information.

Please don't redirect me to any kind of reports or statistics, as the reason for my request directly to you is that these reports, such as AFFALD FRA HUSHOLDNINGER 2018 Albertslund Kommune, produced by you, don't give any information on the end-of-life treatment of furniture.
All of my research sources guided me to you as you are the ones handling furniture waste for Danmarks Internationale Kollegium as well as for Albertslund Municipality, through the Recycling station Albertslund Genbruggstation.
I talked to all of the actors including the Agenda Center, which all said I should talk to you. And finally you are not giving out information so far.
I don't have the feeling that it's a lack of time to answer 6 questions, but rather you redirected me to other parties already in our phone call, even though it is clearly Vestforbrænding, who should be able to give answers to the treatment and amount of furniture.

Hence please try to answer the following questions, redirect me to a colleague or verify why you are not able to answer the questions.
These are:

on DIK:

1) Are you responsible for the waste-management of DIK for furniture-waste?
2) If so, do you have any statistics on the furniture-waste you pick up at DIK?
   - e.g. tons/m3/containers per year
3) How do you handle this waste-stream?
4) How much is recycled and how much is incinerated?
5) How does the recycling process for furniture look like?
   Furniture seems like a complicated waste-stream, that is according to my research often incinerated and mixed waste-streams are often downcycled into a material of lower quality.
6) Which kinds of materials in furniture and to which percentage can you actually recycle (keep resource value), is downcylced (into lower quality resource) and is incinerated?

I hope you find the time to answer these questions.
Kind regards
Tobias Hauptmann

Correspondence Marius Pedersen A/S

Interview Request to Marius Pedersen A/S 14.04.2020

Dear Ladies and Gentlemen,

my name is Tobias Hauptmann and I am writing you as I am in need of information from you for my Master Thesis research of Sustainable Design at Aalborg University.

The thesis investigates *Furniture Waste in Dormitory Environments*, for which I research this topic in general and by means of the case-study Danmarks Internationale Kollegium (DIK) in Albertslund.

During this research I was redirected to your company by the local inspector of DIK, Chresten Nielsen, that Marius Pedersen is responsible for the waste-management of furniture in this dorm.
Do you know if this is correct?

If so I have a few research-questions on the waste-handling you do for furniture, that are necessary for the completion of my research. These are:

1) Are you responsible for the waste-management of DIK for furniture-waste?
2) If so, do you have any statistics on the furniture-waste you pick up at DIK?
   - e.g. tons/m3/containers per year
3) How do you handle this waste-stream?
4) How much is recycled, how much is landfilled and how much is incinerated?
5) How does the recycling process for furniture look like?
   Furniture seems like a complicated waste-stream, that is according to my research often incinerated and mixed waste-streams are often downcycled into a material of lower quality.
6) Which kinds of materials in furniture and to which percentage can you actually recycle (keep resource value), is downcylced (into lower quality resource) and is incinerated?

It would be great if you find the time to answer them by email, as a current meeting wouldn't be possible under these circumstances, I guess.

If you are not the correct person to address, please redirect me to the responsible person of your staff.

I am looking forward for a response.
Thank you, kind regards and stay healthy.

Tobias Hauptmann
Research Student Aalborg University
Sustainable Design Msc. Eng.

Email Answer from Marius Pedersen A/S 15.04.2020

Hi Thomas

Thank you for your e-mail.

Unfortunately we are not able to help you with the required information, as we do not disclose information about customer relations.

Venlig hilsen / Best regards
Kirsten K.

Marius Pedersen A/S

Ørbækvej 851
5863 Ferritslev

Email Correspondence with Employee of Marius Pedersen A/S

Email to Employee of Marius Pedersen A/S

Dear Pia B.,

my name is Tobias Hauptmann and I am writing you as I am in need of information from
you for my Master Thesis research of Sustainable Design at Aalborg University.
The thesis investigates Furniture Waste in Dormitory Environments, for which I research
this topic in general and by means of the case-study Danmarks Internationale Kollegium
(DIK) in Albertslund.

During this research I was redirected to your company by the local inspector of DIK,
Chresten Nielsen, that Marius Pedersen is responsible for the waste-management of
furniture in this dorm.

Do you know if this is correct?
If so I have a few research-questions on the waste-handling you do for furniture, that are
necessary for the completion of my research. These are:
1. Are you responsible for the waste-management of DIK for furniture-waste?
2. If so, do you have any statistics on the furniture-waste you pick up at DIK?
- e.g. tons/m3/containers per year
3. How do you handle this waste-stream?
4. How much is recycled, how much is landfilled and how much is incinerated?
5. How does the recycling process for furniture look like?
Furniture seems like a complicated waste-stream, that is according to my research often
incinerated and mixed waste-streams are often downcycled into a material of lower quality.
6. Which kinds of materials in furniture and to which percentage can you actually recycle
(keep resource value), is downcylced (into lower quality resource) and is incinerated?

It would be great if you find the time to answer them by email, as a current meeting
wouldn't be possible under these circumstances, I guess.
If you are not the correct person to address, please redirect me to the responsible person
of your staff.

I am looking forward for a response.
Thank you, kind regards and stay healthy.
Tobias Hauptmann
Research Student Aalborg University
Sustainable Design Msc. Eng.

Answer from Employee of Marius Pedersen A/S

Hej Tobias

Thank you for your mail.

Are you sure that it is us?
Because I cant find you anywhere in our systems

Can you give me an address, to look up?

On the other hand. The most of the information you need is on our website and the rest you need to have from the Danmarks Internationale Kollegium

Good luck
Venlig hilsen / Best regards

Pia B.

Email to Employee of Marius Pedersen A/S

Hello Pia,

thank you for your quick response.

The address of the dorm, Danmarks Internationale Kollegium, is Vognporten 14, 2620 Albertslund. I was told that you handle some furniture waste respectively metal waste in the dorm, as this was explained by the inspector of the dorm, Chresten Nielsen, during an interview. He explained that you pick it up with a truck that has a crane on it to grab/collect the waste, a service that is visible on your website.
I don't know if this happens regularly or occasionally. He was not superclear if it's only you who handle it, but your company was definitely mentioned, next to Vestforbraending. Otherwise I will try to make sense of your website as good as possible.
But more specific information from you would be better, as included in the questions from the previous email.

Thank you, kind regards and take care

Answer from Employee of Marius Pedersen A/S

Hi Tobias

I cant find anything on Vognporten 14 ? can it be another address?

Venlig hilsen / Best regards
Pia B.

Email to Employee of Marius Pedersen A/S

Hi Pia,

thanks for your effort. This is the correct address.
But then I guess DIK is taking your services only on an irregular basis, as the inspector said, he calls you to
pick-up the waste and maybe for this a permanent registraon is not necessary.
Furniture at the dorm is collected at two places:
There is some furniture collected in a fenced corner, which you can reach only with this crane truck.
And the other furniture waste is collected in another closed container by the inspectors and

I guess this is then Vestforbraendig who is responsible.

Well, maybe you can answer me in general how you treat furniture waste that is incoming to you. Furniture on your website is listed here:
https://www.mariuspedersen.dk/affald/affald-sortering/affald-tilsortering
The treatment says: The sorted cardboard, paper, plastic, wood and iron are disposed of for recycling and waste for incineration for environmentally approved treatment plants. (Google Translator)
How is furniture treated at your company? How much is recycled and how much is incinerated?
And what does recycling mean - Is it converted into a material of the same or of a lower quality?
I guess with mixed products of mixed materials it's difficult to ensure material purity for recycling, isn't it?

I hope it's more clear now. Sorry for the inconvenience.

Kind regards
Tobias

Answer from Employee of Marius Pedersen A/S

Hi Tobias.

It must be another company.

I would have a record if he uses us for picking up furniture
And the rest of the questions, I am sorry to say ; I cant answer them

Venlig hilsen / Best regards
Pia B.

Email to Employee of Marius Pedersen A/S

Hello,

ok, but thanks for your effort and sorry for the inconvenience.

Kind regards and take care.
Tobias

Correspondence REMONDIS A / S - Email

Two emails were send to this company without receiving any answer.

Interview Request via Email (15 + 19.04.2020)

Dear Ladies and Gentlemen,

my name is Tobias Hauptmann and I am writing you as I am in need of information from you for my Master Thesis research of Sustainable Design at Aalborg University.

The thesis investigates *Furniture Waste in Dormitory Environments*, for which I research this topic in general and by means of the case-study Danmarks Internationale Kollegium (DIK) in Albertslund.

During this research I noticed you are handling part of this waste-stream, as you handle the metal waste for DIK. This includes to a certain degree also smaller furniture as blinds or parts of bigger furniture as metal legs of tables.

Hence I have a few research-questions on the waste-handling you do for furniture, that are necessary for the completion of my research. These are:

on DIK:
1) Do you have any statistics on the amount of the waste-stream you pick up at DIK?
   - e.g. tons/m3/containers per year
2) How do you handle this waste-stream?
3) How does the recycling process for this stream look like?
   Are you able to create an end-product from this waste-stream that has the same quality at the incoming materials?
4) How much is recycled, downcycled (lower quality material), incinerated and landfilled?

It would be great if you find the time to answer them by email.
If you are not able to answer these questions due to confidentially or similar, please say so.

I am looking forward for a response.
Thank you, kind regards and take care.

Tobias Hauptmann
Research Student Aalborg University
Sustainable Design Msc. Eng.
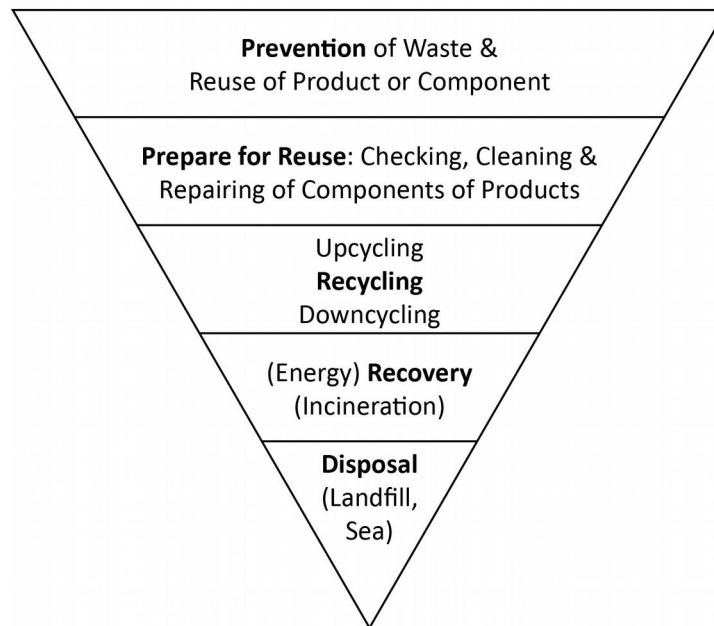
Appendix 17 - Figures & Tables used in Thesis

Figure 1.2: Waste Hierarchy based on (EC 2019a) (EMAF 2013) (Bocken et al. 2016)

Value Cycle Author	Longer Use of Products	Reuse of Products	Refurbishment and Remanufacture of Components	Recycle of Materials
Bakker et al. 2015,	Future proof & Maintenance	Reuse of products	Remake, prolonged use or reuse of components, includes refurbishment, remanufacturing and reconditioning	Reycling, material recovery, reuse of material
Medkova et al. 2016, 3	design for longevity	design for leasing or service, Reuse	design for re-use in manufacture, repair, remanufacture, refurbishment	design for material recovery
EMAF 2015, 50 EMAF 2013, 7	Maintenance	Reuse/ Redistribute	Refurbish/ Remanufacture	Recycle
Arpin et al. 2015, 36	Product maintenance	Product reuse /redistribution	Product refurbishment/ remanufacture	Product recycling

Table 2.1: Overview chart - Different Terminologies for Value Cycles based on literature review (created by author)
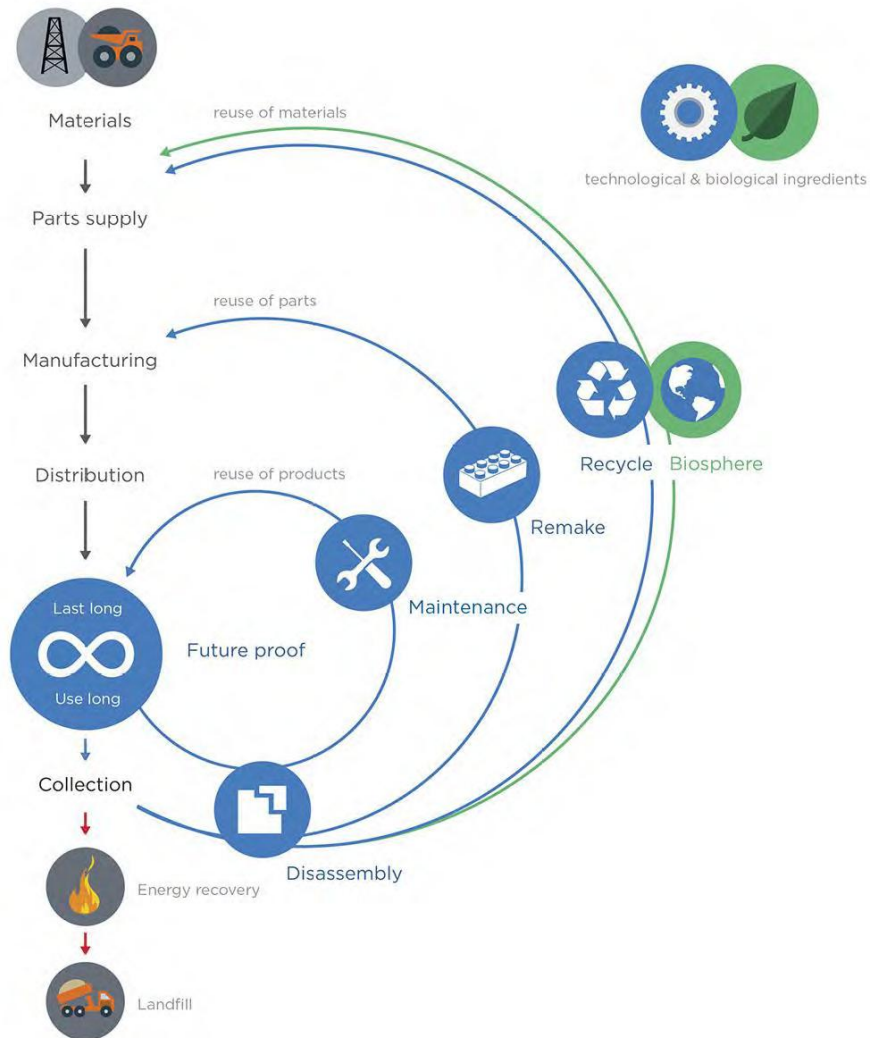
Figure 2.2: Circular product design model (Bakker et al. 2015, 367)

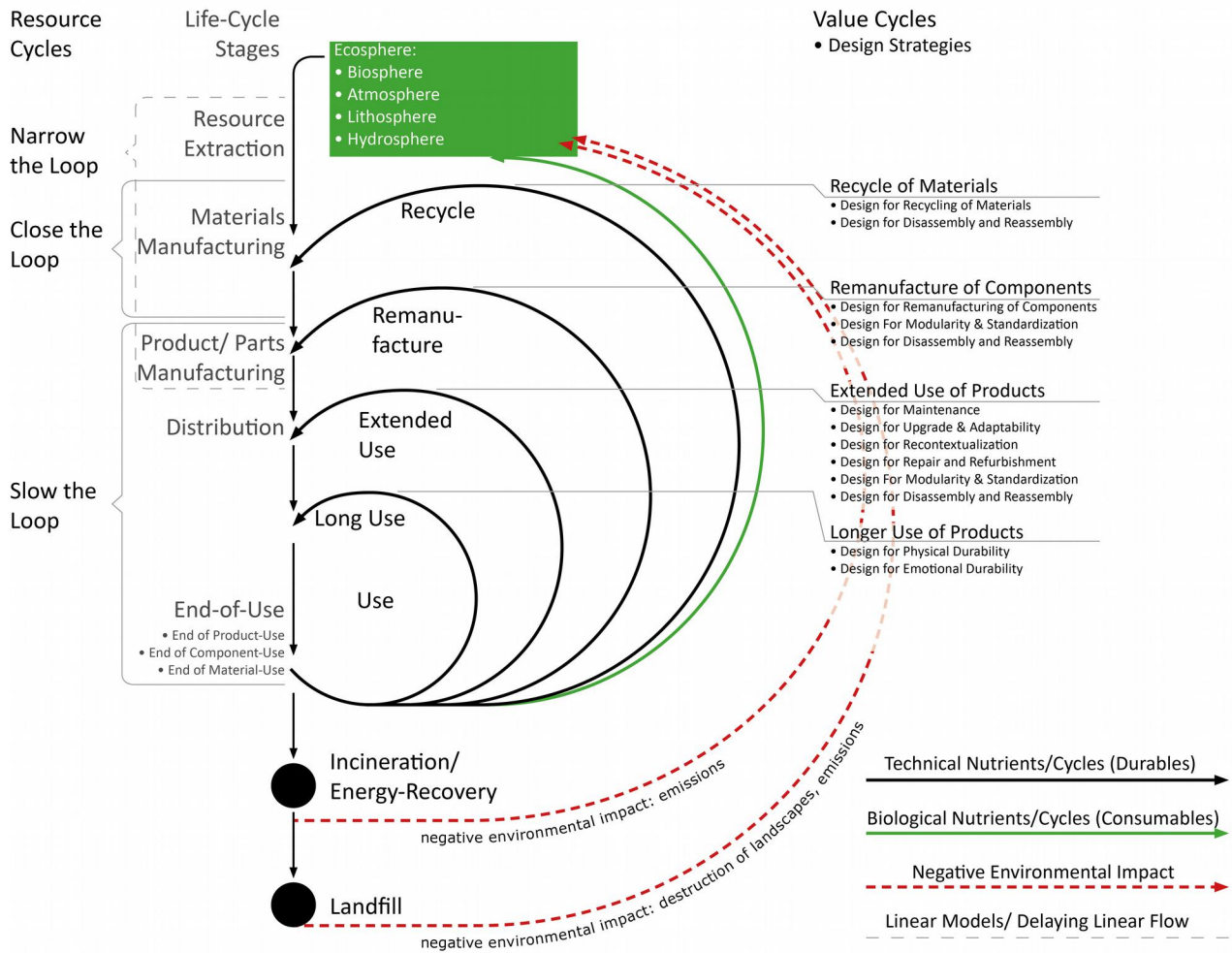| Longer Use of Products	Extended Use of Products	Remanufacturing of Components	Recycle of Materials
Design for Physical Durability Design for Emotional Durability	Design for Maintenance Design for Upgrade & Adaptability Design for Recontextualization Design for Repair/Self-Repair and Refurbishment Design For Modularity & Standardization Design for Disassembly and Reassembly	Design for Remanufacturing of Components Design For Modularity & Standardization Design for Disassembly and Reassembly	Design for Recycling of Materials Design for Disassembly and Reassembly
Table 2.2: Overview Chart of the different Product Design-Strategies according to the Value Cycles (created by author)			

Figure 2.3: Adapted Circular Economy Model Value Cycles and Design-Strategies based on literature review (graphic created by author)

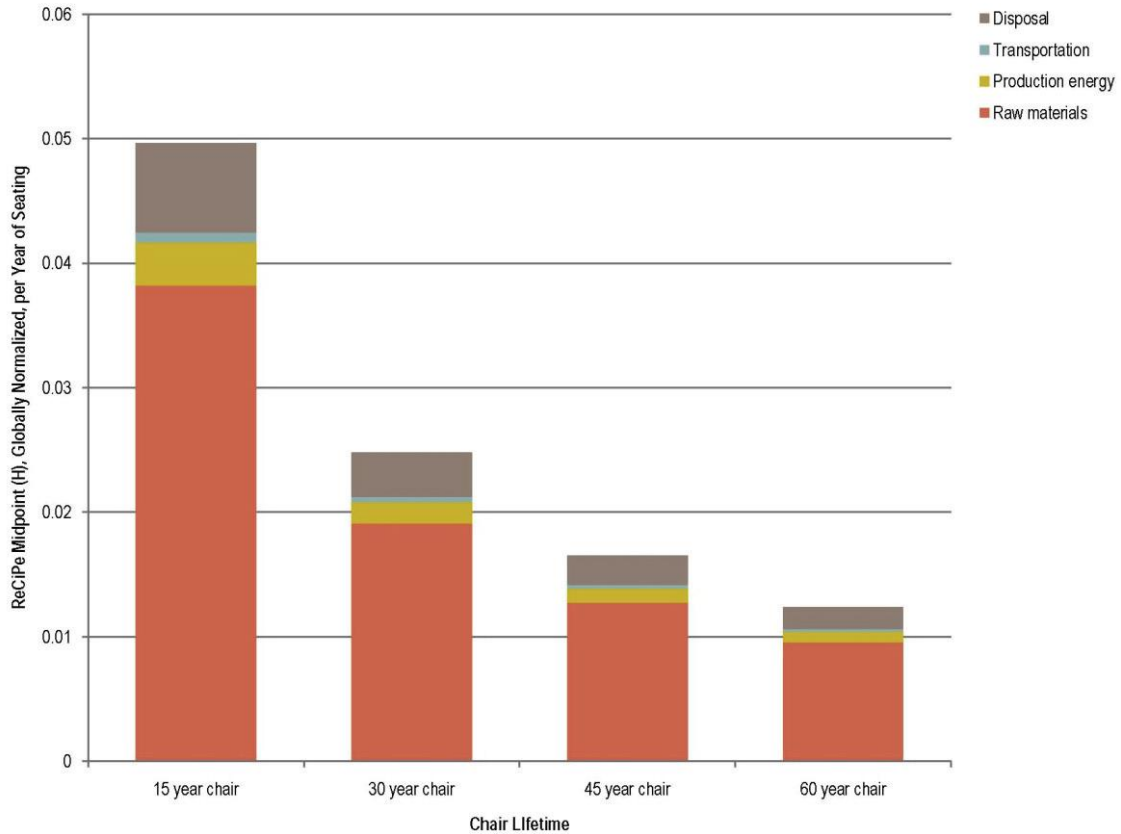| Value Cycle/ Life Phase	Circular Business Model	Sub-Circular Business Model	Authors
Manufacturing	Efficiency	Lean Manufacturing	(Lewandowski 2016) (Bocken et al. 2014) (Nußholz 2017) (Bocken et al. 2016) (Wells & Seitz 2005) (Moreno et al. 2016)
		Industrial Symbiosis	
		Frugal Business Model	
		Others	
	Substitute with renewables and natural processes	Replacing renewable materials with non-renewables	(Bocken et al. 2014) (Bocken et al. 2016)
		Use of local, renewable energy	
		Environmentally friendly production processes	
Longer Use of Products	Classic long life		(Bocken et al. 2014) (Bocken et al. 2016)
	Encourage Sufficiency		
Intensified Use	Shared Use	Shared Use	(Bocken et al. 2016) (Franco 2019) (Bocken et al. 2014) (Korhonen et al. 2018) (Moreno et al. 2016) (Lewandowski 2016)
		Leasing	
	Access and Performance or Product Service System	Result-oriented PSS	
		Use-oriented PSS	
		Product-Oriented PSS	
Extended Use of Product Reuse of Components	Extending Product value	Reuse	(Bocken et al. 2014) (Bocken et al. 2016) (Nußholz 2017) (Wells & Seitz 2005) (Moreno et al. 2016)
		Repair	
		Remanufacturing	
Recycle of Materials	Extend Resource Value	Recycling	(Bockenet al. 2014) (Bocken et al. 2016) (Nußholz 2017) (Wells & Seitz 2005) (Moreno et al. 2016)
Others	Adopt a Stewardship Role	Upstream Stewardship	(Bocken et al. 2014) (Lewandowski 2016)
		Downstream Stewardship	
	Re-purpose the business for society/environment	Social Enterprises	
		Non-profit Organizations	
		'Hybrid' business model	
		Develop scale-up solutions	
	Dematerialized Services		
Table 2.3: Overview Chart of Circular Business Models based on literature review (created by author)			

Figure 4.2: Total Life Cycle Impacts per Year of Seating (Ingham 2011,63)

> Product / > Author / > Env. Impact Unit	Materials/ Preproduction	Production	Distribution/ Transport	Use	End of Life
> Wood furniture/ > (Vicente et al. 2009)/ > *Impact*	*up to 30%.*	*around 50,00%*	*same weigh as in the majority of industries*	*Close to zero*	Not mentioned
> various Wood Furniture/ > (JRC 2013)/ > Global Warming Potential	*Average 74%*	*Average 30%*	*Average 10%*	*0,00%*	*Average 1%*
> Office Desk/ > (Penty 2020)/ > C02kg equiv.	~ 61%	~31%	~6%	~0%	~2%
> office furniture/ > (Plaschke et al. 2019)/ > Midpoint	*100,00%*	*34,00%*	*14,00%*	*1,00%*	Not included
> Two Chairs/ > (Arvidsson et al. 2017)/ > climate impact	*69,00%*	*15,00%*	*5,00%*	*0,00%*	*11,00%*
	85,00%	*2,00%*	*2,00%*	*0,00%*	*10,00%*
> Shell Chair > (Ingham 2011) > Life Cycle Impacts per Year Midpoint H	~77%	~10%	~2%	*excluded*	~15%
Table 4.1: Overview of Environmental Impact for Life Phases (LCA) of Furniture based on literature review (created by author)					

Figure 4.3: LCA Office Furniture – Steelcase Activa desk (Penty 2020, 40)

Based on Waste-Stream [Reference]	Calculation [References]	Total Amount of Furniture Waste kg/capita
Furniture-waste [6]	-	**15 kg/capita (EU)**
Furniture-waste [7]	10.78 million tonnes [7] / 513.5 million inhabitants [8] = 20.99 kg/capita	**~ 21 kg/capita (EU)**
Municipal Waste [1]	Municipal Waste 410.1 kg/cap [1] X 3.75% [7] = 15.38 kg/capita	**~ 15.4 kg/capita (DK)**
Household Waste [2]	447kg/cap [2] X 3.75% [7] = 16.76 kg/capita	**~ 16.8 kg/capita (DK)**
Municipal Waste [3]	747 kg/cap [3] x 3.75% [7] = 28.01 kg/capita	**~ 28 kg/capita (DK)**
Municipal Waste [4]	766 kg/cap [4] x 3.75% [7] = 28.73 kg/capita	**~ 28.7 kg/capita (DK)**
Bulky Waste [9]	145-240 kg/cap [9] x 30-40% [10] = 43.5-96.0 kg/capita	**~ 43.5-96.0 kg/capita (DK)**
Bulky Waste [calc. based on chart XX]	102.9 kg/cap [1] - 192.3 kg/cap [4] x 30-40% [10] = 30.87 – 76.92 kg/capita	**~ 30.9-76.9 kg/capita (DK)**
References: [6] (EEA 2018); [7] (Forrest et al. 2017); [3] https://ec.europa.eu/eurostat/statisticsexplained/index.php/Population_and_population_change_statistics [1] (CRI et al. 2016); [2] (DG 2013); [3] (DG 2015); [4] (Eurostat 2019); [9] (Larsen et al. 2012); [10] (CoC 2014)		
Table 4.2: Total Annual Furniture Waste in kg/capita in Denmark & EU based on literature review (created by author)		

Calculation Chart for Table 4.2 - Total Annual Waste in % and kg/capita in Denmark				
26.4 % Building and construction sector [2]	~29.3 % Industry [2]	Service sector, including public institutions [2]	Utilities and other commercial waste [2]	Household Waste 447kg/cap [2]
Municipal Waste 410.1 kg/cap [1] / Household 447kg/cap [2] / Municipal Waste 747 kg/cap [3] / Municipal Waste 766 kg/cap [4]				
22.6% paper and cardboard [1]	14.9 % glass [1]	4.2 % plastic [1]	7.0 % metal [1]	26.2 % bio-waste [1]	**25.1 % other** (like **bulky waste**, impregnated wood, PVC, hazardous waste, batteries, etc. but excl. WEEE, tyres and)
92.7 (kg/cap)	61.1 (kg/cap)	17.2 (kg/cap)	28.7 (kg/cap)	107.4 (kg/cap)	**102.9 kg/cap** [1] **- 192.3 kg/cap** [4]
					30-40% [5]
					= **30.87 – 76.92 kg/cap**
References: [1] (CRI et al. 2016) ; [2] (DG 2013); [3] (DG 2015); [4] (Eurostat 2019); [5] (CoC 2014)					

Disposal methods	Total Amount Disposal (%)
Discarded as waste	**106 (26.7%)**
Discarded the item in a collection bin for second-hand products.	**16 (4.0%)**
Donated to a thrift shop or other similar organization	**81 (20.4%)**
Recycled via curbside recycling or sold/donated it to a recycler	**16 (4.0%)**
Returned to municipality during a special collection	**3 (0.8%)**
Sold on yard sale or swap event	**34 (8.6%)**
Sold or donated via a material exchange	**11 (2.8%)**
Sold or donated via online classifieds.	**60 (15.1%)**
Sold or donated via word of mouth	**70 (17.6%)**
	397 (100.0%)
Table 4.3: Disposal methods for Furniture (based on Table 6 Fortuna et al. 2017, 2461) (created by author)	

Types of Waste [Reference]	Recycling	Incineration	Landfilling	(Compos ting)	(Other)
Municipal Waste (EU 28 – 2018) [4]	~ 29.9%	~ 27.9%	~ 22.7%	~ 17.1%	~2.4%
Households Waste (Denmark) [2]	36,00%	56,00%	4,00%		
Bulky Waste (Denmark) [9]	50–60%	30–40%	10,00%		
Furniture Waste (EU) [7][11-13]	10,00%	80-90%			
Furniture Waste [10]	Metal; "secondary raw-material"	Everything (except metal)	-		
References: [2] (DG 2013) [4] (Eurostat 2019) [9] (Larsen et al. 2012); [7] (Forrest et al. 2017); [10] (Fuentes 2017) [11] (FURN 360); [12] (JRC 2013); [13] (Parker et al. 2015)					
Table 4.4: Overview Chart - Waste & Furniture Waste Treatment in Denmark & EU based on literature review (created by author)					

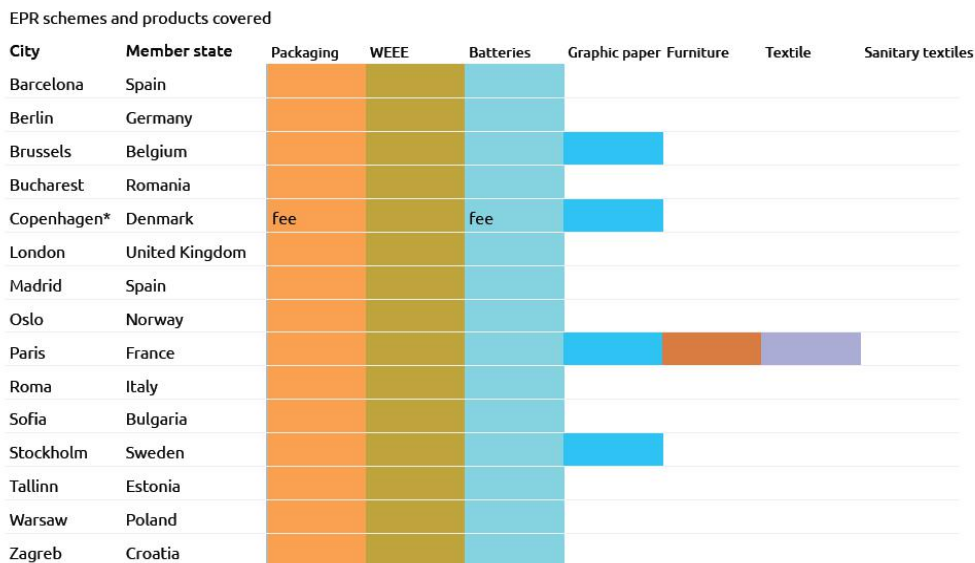| Furniture (1 tonne)	Direct Reuse (e.g. second-hand shop or eBay)	preparation for reuse network
Sofa [a]	1.45 tonnes (ca 55kg CO2 eq per sofa)	1.05 tonnes (40kg CO2 eq per sofa)
Dining Tables [a]	0.38 tonnes (ca 10kg CO2-eq per table)	0.76 tonnes (ca 20kg CO2-eq per table)
Office Desks [b]	0.4 tonnes	0.2 tonnes
Office Chairs [b]	3 tonnes (ca 35kg CO2-eq per chair)	2.6 tonnes (ca 30kg CO2 -eq per chair)
[a] (Fisher et al. 2011a); [b] (Fisher et al. 2011b)		
Table 4.5: Benefits of Reuse for different types of Furniture: Greenhouse Gas savings per tonnes of furniture in tonnes CO2- eq. net. compared to landfill (Fisher et al. 2011a, 2011b) (created by author)		

Figure 4.4: Existing EPR schemes andproducts covered (FPRCR 2015, 11)

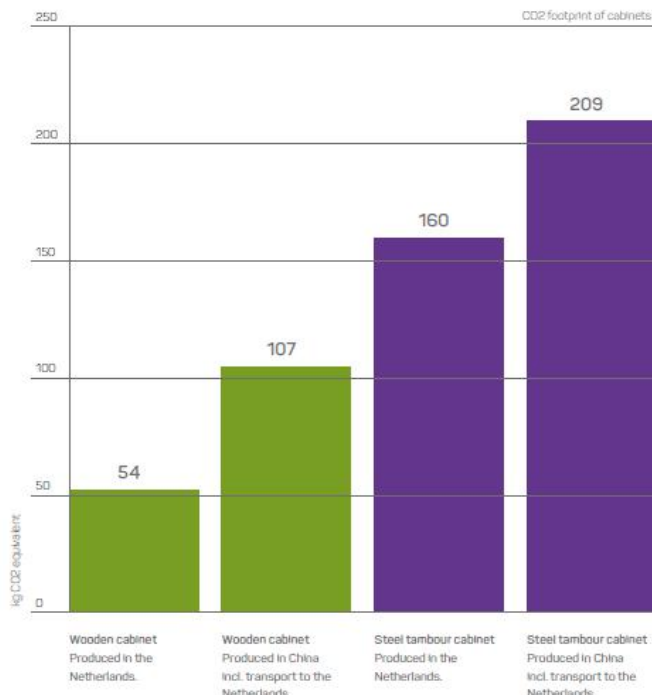*Figure 4.5: Circular Economy Framework (Gispen 2015,22-23)*

*Figure 4.7: The CO2 footprint in the production of cabinets
(incl. transport) (Vepa B.V. 2019, 23)*

Figure 4.9: Vitsoe's 606 Universal Shelving System (Architonic 2020)

Figure 4.10: Modular seating system (Bosch et al. 2017,320)

Figure 4.11: Modular shelving system (Penty 2020, 267)

Figure 4.12: Peter Osvik's Tripp Trapp Chair (Penty 2020, 254)

Figure 4.13: Mirra Chair disassemlbed into recyclable parts (Rossi et al. 2006, 199)

Figure 4.14: Flatpack table (Penty 2020, 276)

Figure 4.15: iFixit's Repair Manifesto (iFixit 2020)

KBH
~22000

CIU
~15000

KKIK
~ 8100

~ 0.4% ~36.9% ~62.7%

unfurnished

most likely unfurnished

furnished

no information provided

DIK
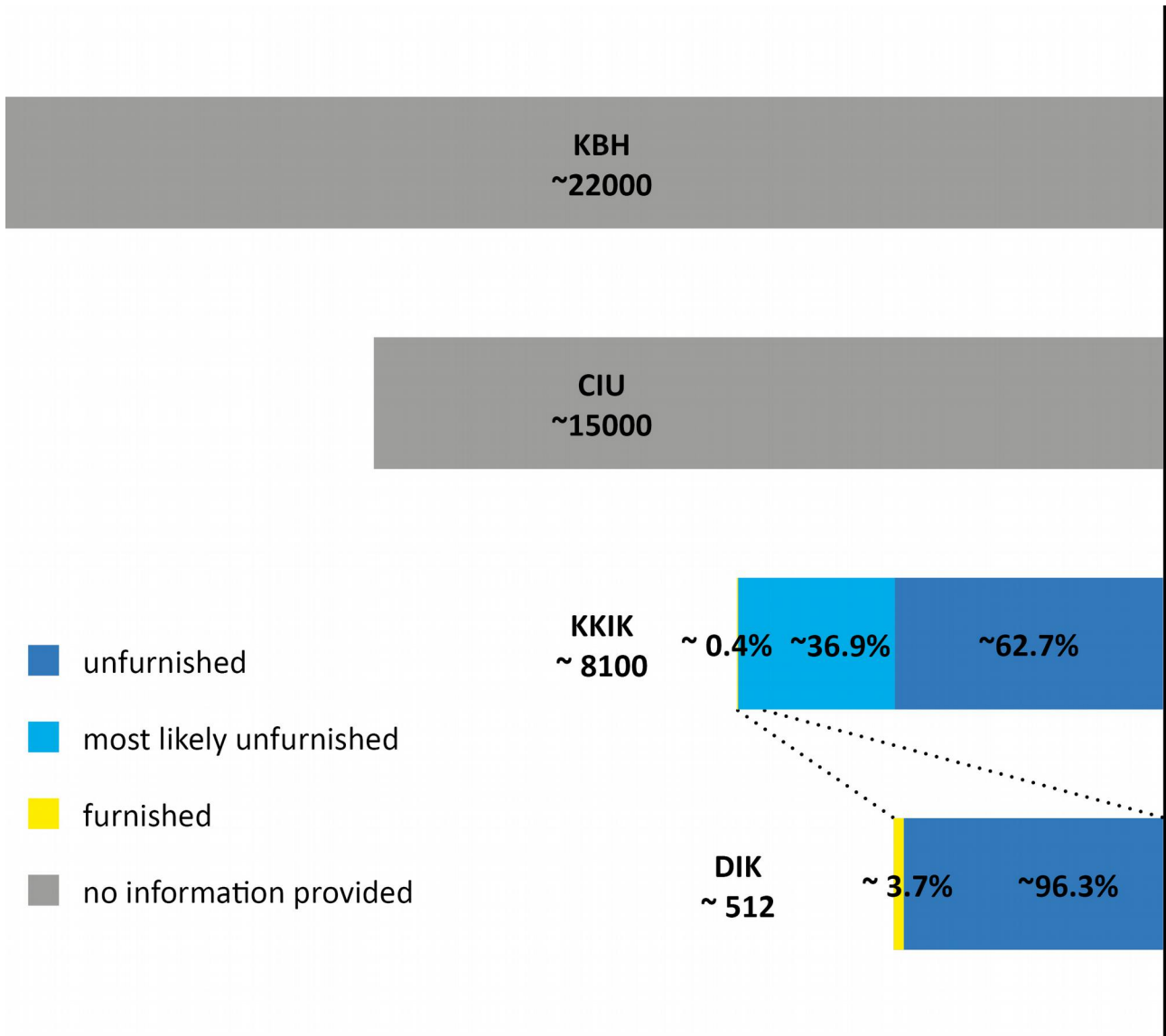~ 512

~ 3.7% ~96.3%

Figure 5.1: Housing Organizations in Copenhagen Area - Amount of Rooms Furnished
(App. 2, 3 - Graphic created by author)

Figure 5.3: A Room for one person at DIK - unfurnished (DIK 2020)

Figure 5.6: The previous shelving system of the rooms (photos taken by author)

Figure 5.8: Chair removed from block to waste area by inspectors (photos taken by author)
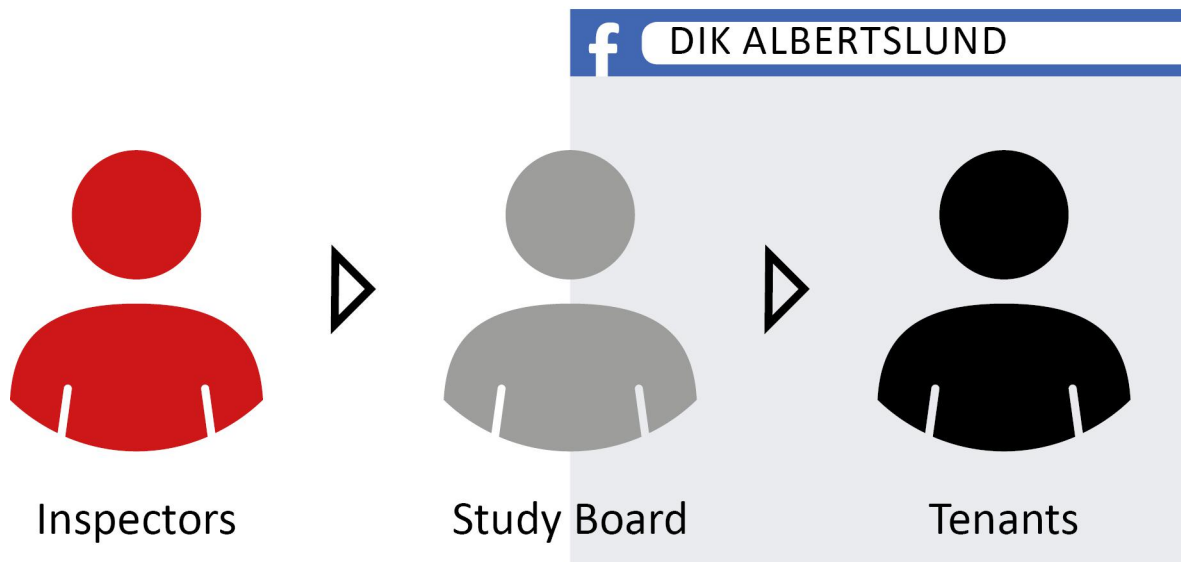
Figure 5.10: Schema for Communication at DIK (Graphic created by author)

Trade/Marketplace							Other Topics							
Furniture-Offer	Furniure Request	Household-Item Offer	Household-Items Request	Other items Offer	Other items Request	Lending/Borrowing/Sharing Item	Key/Locks/Doors	Something Doesn't work in dorm	Social Issues/Complaints	Social Event	Subrenting / Renting	Other Information Requested / provided	Official Information from DIK / Information Requested Living at DIK	Others
Total numbers: Absolute & Percent (300 posts)														
29	8	13	6	21	15	30	6	25	14	6	8	33	56	30
9.7%	2.7%	4.3%	2.0%	7.0%	5.0%	10.0%	2.0%	8.3%	4.7%	2.0%	2.7%	11.0%	18.7%	10.0%

Table 5.1: Overview Topics Posts Facebook Group DIK Albertslund (Reference Chart see App. 12) (Created by Author)

Type of Request						Type of Item								
Amount of Posts	Want to Sell	Want to buy	Want to give away	Want to Dispose	Other	Furniture in general	Sofa	Bed/Mattress	Lamp	Chair / Seat	Shelve	Desk/Table	Others Furniture	Other Household Items
139	87	24	26	4	2	11	16	37	13	23	24	32	16	20
%	~60.8%	~14.6%	~15.9%	~2.4%	~1.2%	~5.7%	~8.3%	~19.3%	~6.8%	~12.0%	~12.5%	~16.7%	~8.3%	~10.4%

Table 5.2: Analysis of Facebook Group DIK Albertslund – Furniture Trade (Reference Chart see App. 12) (Created by Author)
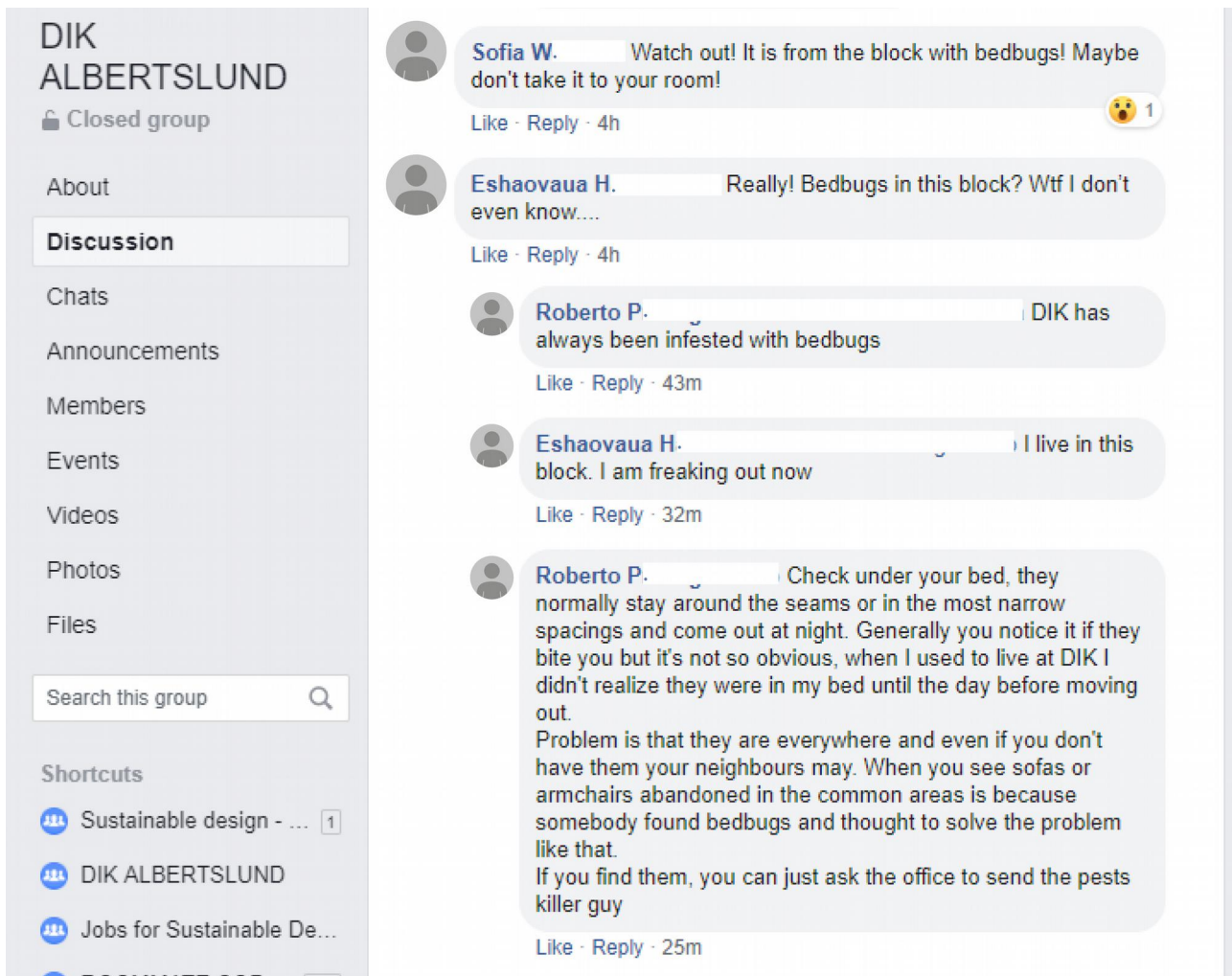
Figure 5.12: Screenshot from DIK Facebook Group – Discussion on Bedbugs

Amount	Bed / Bed-frames	Mattresses	Chairs	Sofas or Sofa-bed	Desks/ Tables	Shelves	Blinds	Lamps	Carpets	Others	Furniture-Equipment
164	15	13	16	5	21	17	25	8	7	16	21
100,00%	~9.1%	~7.9%	~9.8%	~3.00%	~12.8%	~10.4%	~15.2%	~4.9%	~4.3%	~9.8%	~12.8%
Others		3 Woodboards; 3 clothes stand/parts of; 1 Table-Legs; 1 Part from Bed; 1 Piano (Made in Denmark); 4 Mirrors; 1 White board; 1 Foldable wardrobe; 1 Wood frame,									
Furniture-Equipment		1 Pillows (normal, sofa, chair); 2 clothes hangers; 2 Bedclothes; 1 mattresses protector ; 4 Shower equipment (curtain, hose, rail); 1 basket from closet; 1 Floor protector f. desk									

Table 5.3: Overview of Documented Furniture Discarded by Type (Reference Chart see App. 9)
(Created by Author)

Amount	Household Items	Clothes /Textiles	Electronic Items
166++	65	52	49
100,00%	~38.9%	~31.1%	~29.9%

Table 5.4: Overview of Documented Items discarded besides Furniture
(Reference Chart see App. 9) (Created by Author)

Products	Directly usable		Needs Cleaning		Needs repair/ refurbishment		Only Parts usable		Recyclable		Not clear	
	amount	percentage	amount	percentage	amount	percentage	amount	percentage	amount	percentage	amount	percentage
Furniture	20	~12.2%	57	~34.8%	40	~24.4%	15	~9.1%	3	~1.8%	29	~17.7%
Household-items, clothes, electronic items etc.	21	~12.7%	88	~53.3%	8	~4.8%	2	~1.2%	0	0,00%	46	~27.9%

Table 5.5: Condition of Documented Furniture and Household-items Discarded (Reference Chart see App. 9) (Created by Author)

Products	In bin		In front of bin/on street	
	amount	percentage	amount	percentage
Furniture	36	22.5%	128	77.5%
Household-items, clothes, electronic items etc.	29	~17.6%	136	~82.4%

Table 5.6: Discarding Place of Documented Furniture and Household-items (Reference Chart see App. 9) (Created by Author)

Figure 5.18: Furniture discarded – Before Reuse (Photos taken by author)

Figure 5.18: Furniture discarded – after Reuse within ca. 18h (Photos taken by author)

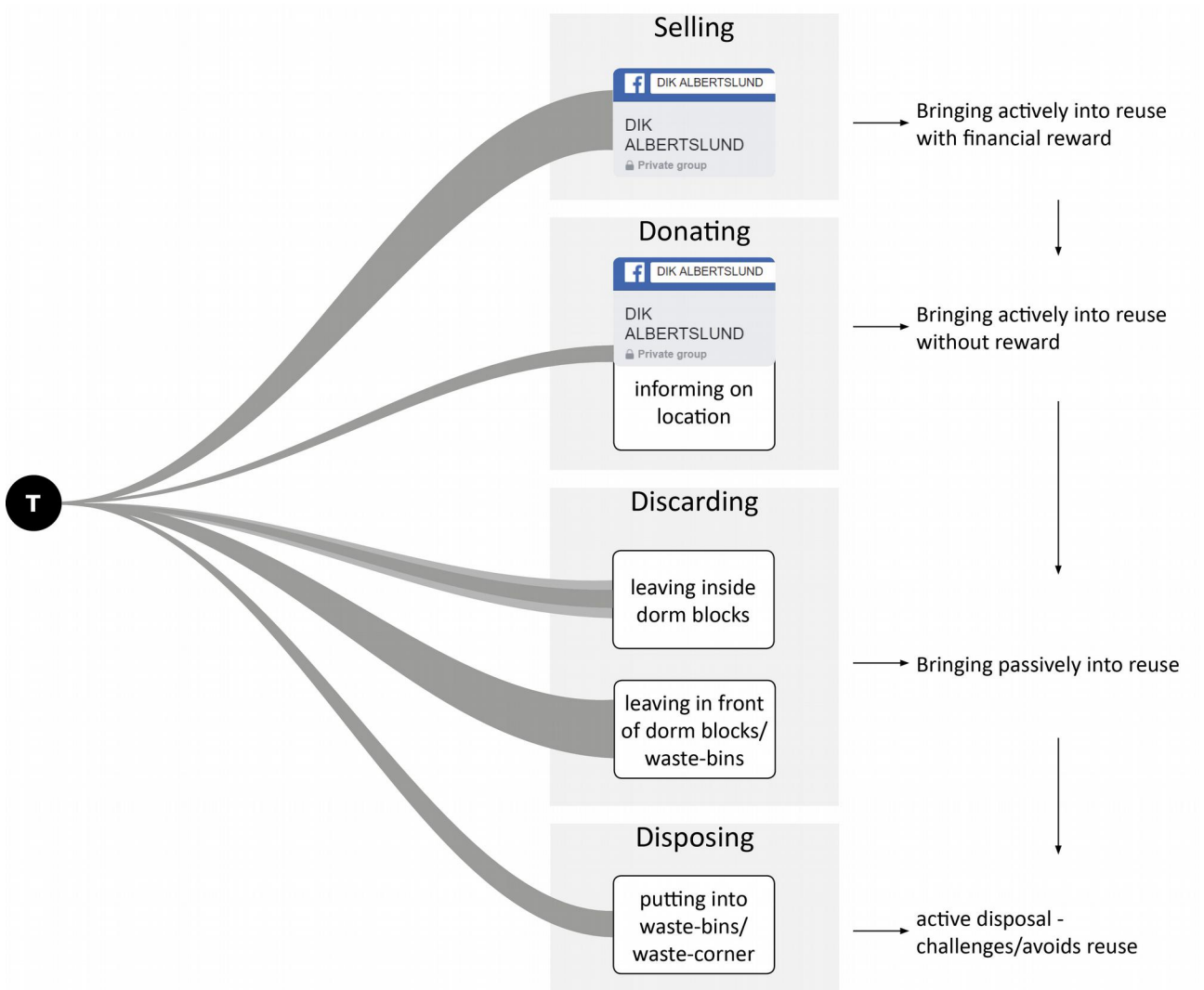| Products	Yes		No		not clear	
	amount	percentage	amount	percentage	amount	percentage
Furniture	24 1/2	~14.8%	88 1/2	~53.6%	52	~31.5%
Household-items, clothes, electronic items etc.	21	~12.7%	35	~21.2%	110	~66.7%
Table 5.7: Reuse Ratio of Documented Furniture and Household-items Discarded (Reference Chart see App. 9) (Created by Author)						

Figure 5.19: Practices of Tenants for Furniture at End-of-Use (Graphic created by author)

For Free - Used

14/36 — was a gift/given away from someone (in the dorm)

12/36 — picked it up in front of the dorm

1/36 — other Facebook groups

Buying - Used

2/36 — Second-Hand Shop

16/36 — bought used directly from someone else

16/36 — DIK ALBERTSLUND
f DIK ALBERTSLUND
DIK ALBERTSLUND
🔒 Private group

Buying - New

22/25 — IKEA

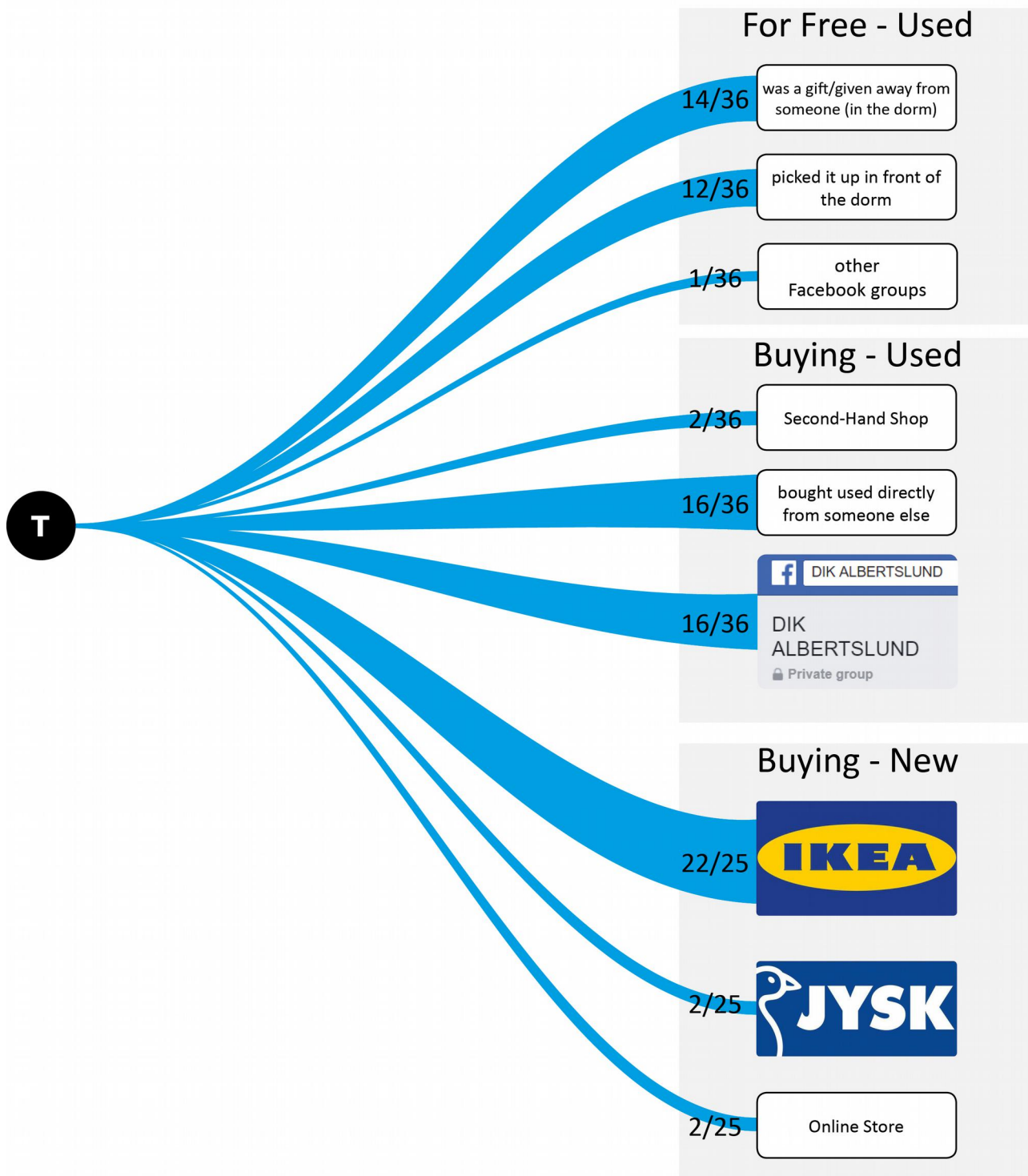2/25 — JYSK

2/25 — Online Store

Figure 5.26: Schema Practices to Obtain Furniture by Tenants (based on survey)
(Graphic created by author)

Figure 6.1: Discarded Products: Sofa made from Particleboard with material-breakage (middle)
& Sofa made from multiple materials (right) (Photos taken by author)

Figure 6.2: Discarded Bed – Materials permanently attached (left & middle) &
Mattress disassembled into cover, springs and upholstery (Photos taken by author)

Figure 6.3: Discarded Items: Disassembled Bed-frame; Chair destroyed (Photos taken by author)

Figure 6.3: Discarded Items: Piano (Photos taken by author)