Circular Economy in renovation practices

A case study of the Building Renewal Unit

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MASTER THESIS - Student nr. 20165052

Abstract

This report investigates how the Building Renewal Unit (BRU) an agent within the Municipality of Copenhagen (MCPH) in which co-fund renovation of private properties, can accelerate development of circular renovation-practices. The report focusses on: 1) how external advisors and the employees in BRU perceive BRUs role in terms of accelerating development of the circular economy through renovations 2) how BRU can accelerate development of circular economy within the legal and organisational framework that applies to the unit 3) How BRU can improve their capacity to facilitate circular measures in the renewal-projects 4) what challenges and opportunities BRU have in regard to facilitating measures that can accelerate development of CE in renovations. This is examined through the perspective of the four teams in BRU, condemnation-team, political team, caseworkers, and the R&D-team and representatives from four adviser-firms in which BRU usually collaborate with. The main empirical basis of the report is five internal interviews with BRU-employees, and four interviews with external advisors, supplemented with four interviews with BRU-caseworkers, conducted by an intern in BRU, desk research and a conference about sustainable construction. The analysis is based on the theoretical perspectives, the Multi-Level Perspective (MLP), combined with governance-concepts and Strategic Niche Management (SNM). Based on this, the report finds that BRU believe they should accelerate development of CE, however they have no strategy or procedure to facilitate measures that can lead to circular outcomes. Further, the report finds that BRU needs to change their processes and premise of funding to enhance their capacity to facilitate circular outcomes in the renovations. Upon this, recommendations for new processes and criteria of funding are presented, these revolve around collaborative processes, where property-owners need to make motivated applications to argue why BRU should fund the projects. Thus, the premise of projects could e.g., be space-optimisation of apartments to make the living-space suitable for shared living. Finally, the discussion suggests that BRU has expertise to lead projects to circular outcomes, and if the recommendation of the report is implemented this may be done without increasing the workload for the employees. However, it may be difficult to muster the resources required for developing a new administrative foundation of the unit, and the political level in MCPH may not agree that the operation of BRU need to change in the direction suggested in this report.

Foreword

This master thesis is written by Frederik Lund Nielsen MSc. Sustainable Cities within the theme circular economy and sufficiency. Within this theme, the report focuses on how the Building Renewal Unit can facilitate measures to accelerate circular outcomes through the renovation-projects they are involved in.

I have been working in BRU for the past two years myself, and I would like to thank my colleagues for letting me interview them and being supportive by putting me in contact with external advisors, which has been a major attribute to this study. On this note, I would also like to thank the external advisors, Eric Prescott, Mette Gammelby Kruse, Nicolaj Niebling and Ulla Beilin for their contribution.

References and Appendices

References are done by referring to the sources by last name and year of publication, e.g. (Geels 2002) or in the text, like this Geels 2002. Authors with more than one publication in the same year are numbered a, b, c etc. Quotes are indented and made text-size 11, unless it is two lines or less, then it is put in “quotation marks” and integrated in the text. Further [...] is used to show if parts of the citation are left out. Specific phrases or word are made **bulky**.
Appendices 1-18 contains the empirical material of this report, and a list of the appendices can be found at the end of the bibliography and the appendices are uploaded in Digital Exam.

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Definitions

Advisors: Technical advisors from architect- & engineering-firms. The advisor's function is to make sure that applicants have the best possible change of gaining funding for their renovation project.

Applicant: Private or cooperative housing associations or rental-companies.

Caseworkers: One who administers the applications and chooses who to fund.

Demonstration-project (demo-project) in the Building Renewal Unit: is defined as a (sub-) project that contributes new knowledge to urban renewal-projects, by testing a technology, a system, or a method. The project must have the potential for scalability in more urban renewal and renovation projects in the future, and the results must be measured (KK 2021b).

Outline of the project

Problem area: Understand how the Building Renewal Unit (BRU) can act as a change agent that can facilitate initiatives to accelerate Circular Economy in building-practices.

Introduction: Present elements that hamper transition to a circular economy in the building sector and describe how BRU work with CE.

Problem formulation: How can the Building Renewal Unit in the Municipality of Copenhagen facilitate measures to accelerate development of the circular economy in the building sector? This is investigated through interviews employees of BRU and external advisors which has all worked with BRU on several projects.

Research questions:

1) How do external advisors and the employees in BRU perceive BRUs role in terms of accelerating development of the circular economy through building renovations?

2) How can the Building Renewal Unit accelerate development of circular economy within the legal and organisational framework that applies to the unit?

3) How can the Building Renewal Unit improve their capacity to facilitate circular measures in the renewal-projects?

4) What challenges and opportunities does the Building Renewal Unit have in regard to facilitating measures that can accelerate development of circular economy through building renovations?

Realization tasks

1) Get insights into how employees in BRU and external advisors perceive BRUs role in relation to accelerating CE.

2) Get insight into the operation space BRU have in terms of incorporating initiatives that can provide circular outcomes in the renovation-cases.

3) Get insights into the organizational and managerial framework that applies to the unit.

4) Reflect upon the analysis, theoretical framework and discuss the opportunities and challenges BRU have in terms of realising circular outcomes in the renovations-cases

Theory: Transition theory, Governance Theory.

Research design: Case study

Methods: Interviews, desk research, field notes.

1. Introduction

Sustainability in the built environment has traditionally focused on emissions from energy production and consumption. This centralised focus has failed to consider the 45% of GHG-emissions that are related to production-processes of materials, products, and food (Ellen MacArthur Foundation, 2019). Accordingly, 90% of biodiversity loss and water stress results from resource extraction and processing of materials, fuels, and food (EC 2019). Further, global human-made mass exceeds all living biomass (Elhacham et al., 2020) while consumption and production are only increasing, while only 8.6% of materials are being circulated globally (Circular Gap Report 2021). These are symptoms of the insufficient societal systems in which human consumption-dynamics is based, and it contributes significantly to the level of GHG-emissions and unsustainable use of natural resources. Further, the building sector is responsible for a large part of these environmentally unsustainable activities, by contributing around 35% of CO2 emissions, 50% of all extracted materials and 35% of the EU's total waste generation (Eurostat data for 2016). Thus, within the EU renovation of the existing buildings are one of the key measures to lower and slow the massive use of materials.

The member-states' annual renovation rates vary from 0.4 to 1.2% and this need to at least double to reach the EU's energy efficiency and climate objectives. It is further emphasised in the EU Green deal that renovation-practises should correspond to circular design-criteria. Thus, building-parts should be sturdy and installed in a way that makes maintenance easy (EC 2019 p. 9).

In turn, Denmark salvages large quantities of materials and has one of the EU's largest material footprints per person, in 2019 Denmark's material consumption was 86% bigger than the average of an EU-citizen. In fact, 4.3 earths would be needed to suffice if all people on earth lived as Danes (Global footprint network 2021; Information 2021). Accordingly, 40 % of these materials are used in the building sector and the most significant part of these are, non-metallic minerals (sand, rock, gravel) which is applied to make concrete, road fill and coastal protection walls, etc. (VCØB, 2021).

1.1 The building mass as a resource-bank in a circular economy

Circular Economy (Hereafter, CE) is inspired by nature's regenerative cycles. Accordingly, it is about reducing the environmental impact of human-activities and providing access to materials by retaining products and resources in circular material flows (Ellen Macarthur 2013). In modern society, the value-chain of material flows are often complex and relies heavily on imports in a transborder trading-system. According to Giljum et al. 2016 the materials that are utilised within the EU are increasingly being extracted outside of the EU, especially in China. Thus, in the EU, resource-extraction has decreased from 68% to 35%, in the years between 1995-2011 (ibid.). Further, industrialised production accelerated rapidly after World War two. Within the building-sector, this led to a shift from craft-traditions, like timber frame and all masonry-constructions, to new building-traditions, based on standardised homogenous materials and prefabricated elements (Engelmark 2013). While this has made it easier and cheaper to develop buildings, it has also led to a conservative system, based on construction-practices that does not align with keeping materials in circular flows. Today, it is considered innovative to design a building that can be disassembled, rather than demolished (Circle House Lab 2020). Thus, before 1950, it was common practice to construct buildings that could be dismantled, e.g., an all-masonry construction with lime mortar (Engelmark 2013; VCØB 2021). However, in the decades after 1950 steel and concrete-constructions started to become the norm, and 69% of all Danish buildings are erected after 1950 (VCØB 2021; Boligøkonomisk Videnscenter n.d.). Subsequently this means, that most buildings are not designed for easy dismantling, thus, embedded components are difficult to salvage for high value purposes. Accordingly, Rambøll 2020, has published an analysis of 16 building-cases which indicate that renovating buildings, is both economically and environmentally beneficial, and existing buildings can be changed a lot before it equals CO2-emmisions of a new construction (Realdania 2021). Thus, activities in the Danish building sector should be focused on maintaining and improving the existing building-mass.

1.2 Circular Economy

General strategies in the circular economy are maintenance, reuse, refurbish/remanufacture and recycling. The purpose is to create opportunities for continued societal development that ensures health, education, energy, social equality, food, and housing in a regenerative way that does not exceed nature's limits to uphold ecosystems - the so-called planetary boundaries (Rockström 2009).

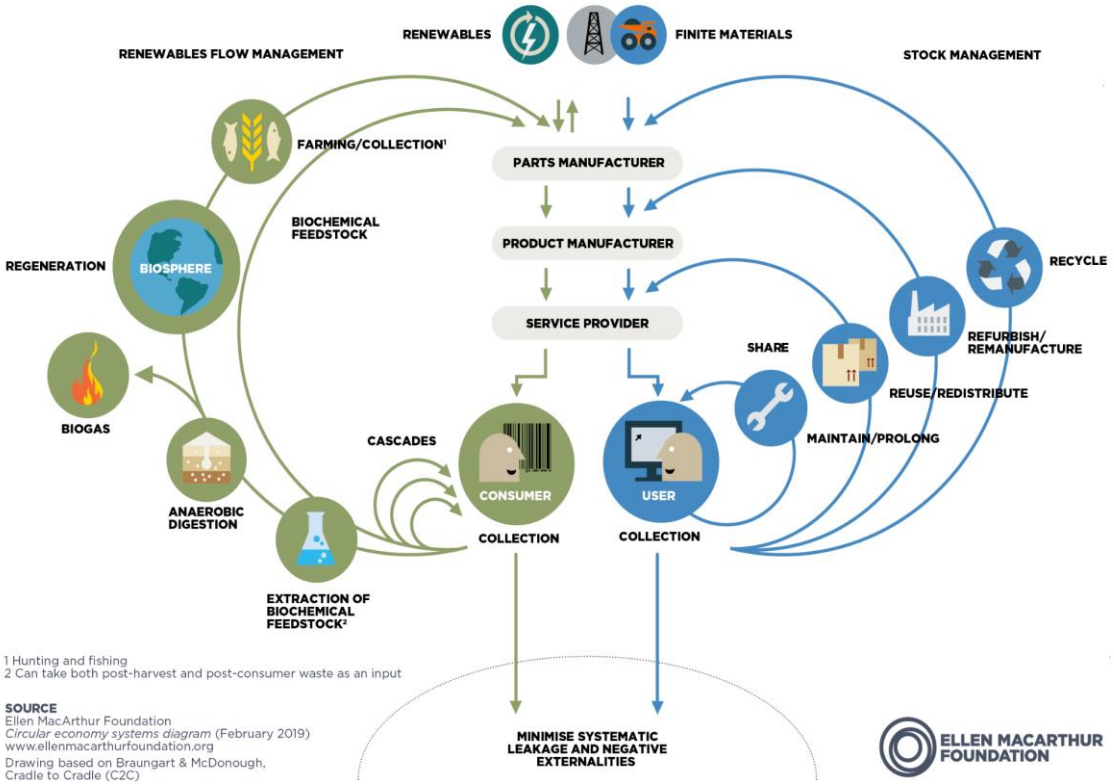


Figure 1. Circular Economy Butterfly diagram (Ellen MacArthur Foundation 2013)

According to the Ellen MacArthur Foundation 2013 CE can be conceived through two overall categories, **the technical cycles, and the natural cycles** which comprise:

- **Share** to extent the use of products and decrease consumption.
- **Maintain/prolong** by designing for durability, continuous maintenance, and repair.
- **Reuse/redistribute** use a material or product for the same purpose multiple times through little preparation or enhancement.
- **Refurbish/remanufactur**e by restoring value to a product by repairing or enhancing the properties of the product by adding components to bring the product up to date.
- **Recycle** by processing materials in the production-processes of creating new products. These processes will often require more energy than those cycles closer to the centre of the diagram, cf. figure 1. Further embedded labour, energy and the costs of reproducing products entirely makes recycling a less desirable option if the closer cycles are possible options.
- **Cascades**: The natural cycles comprise cascades which relate to materials and products that does not contain environmentally hazardous substances, which make them able to be reused and stay in the inner circles of CE, and when a material is no longer usable it can as a last instance be bio-degraded and become nutrients.

1.2.1 Reducing consumption by sufficiency

In terms of circular strategies, reducing consumption cannot only be about efficient use of materials in an industrial setup. Rather, cities also need solutions relating to consumption dynamics. Essentially, redistributing services and materials to lower consumption. (Bjørn et al. 2018; Bocken 2020: Campbell-Johnson 2019: Fratini 2019: Flynn & Hacking 2019: Saheb 2021). According to Bjørn et al. 2018 it is impossible to reach a sustainable future by the current efficiency-measures applied to decrease the impact of goods and services.

The perspective of lowering consumption by making sufficient solutions, e.g., sharing a space for multiple purposes, are however often neglected and focus is often turned to policies and actions related to making processes more efficient.

Thus, efficiency is about doing more with less in relative terms, thus, without considering planetary boundaries, which in many cases are how sustainable actions are measured, in the building sector and in general.

Life Cycle Assessments (LCA) is an example of this, as these assessments do not necessarily lead to insights about the impact of consumption in absolute terms but makes it possible to compare the impact relatively to other activities, for instance building parts that are materially different, but made for the same purpose. In turn, sufficiency is about balancing consumption in correspondence to the biophysical limits of the planet (Princen 2003; Rees 2021; Rockström 2009; Downing 2019).

In turn, tools that aim to calculate impact in absolute metrics are emerging, this approach is called absolute sustainability or Life Cycle Impact Assessment. The approach aims to provide a framework for assessing the sustainable performance of products, e.g., comparing a buildings environmental impact in relation to environmental carrying capacities. Lynge & Ring 2020 for instance calculated the impacts of a standard Danish house opposed to the innovative Upcycle House by Lendager Group in which secondary materials have been applied. The buildings both superseded Planetary Carrying Capacities (PCC), the standard house utilised 365-689% of the available PCC and Upcycle house utilised 126-237% of the PCC (Lynge & Ring 2020 p. 4). This reveals the significance of considering consumption in absolute terms, since a building or a product can appear to be sustainable, because it holds less impact than alternatives, yet it does not necessarily correspond to sustainable consumption (Lynge & Ring 2020 p.4; Niras 2020 p. 23).

Regarding the built environment, sufficiency-measures are paramount, and big cities can play an important role, since the global population and migration to cities are increasing (UNEP 2019), two aspects that create possibilities of utilising, space, energy, and goods more sufficiently. In turn, the spatial element delves into several elements of sustainable development. When people gather in cities there is more space left for other species, which is a gain for biodiversity. Furtherly, energy can be utilised more efficiently in interconnected flexible energy-systems, which leads to less consumption of both energy and materials for infrastructure (Klocker et al. 2012; Klocker 2017; Heinonen & Junnila 2014; Berrill & Hertwich 2021). Finally, decreasing m2/person can decrease consumption because people buy less goods for smaller homes (Aro 2020).

These aspects relate to a scenario in which humans needs for food, goods, energy, and shelter are met in an altogether more sufficient way. Thus, according to Saheb 2021, Danish citizens utilise 58 m2/person the largest share of m2 of all EU-countries. While Copenhagen does not have the largest share of big dwellings, the average size has increased in recent years, especially between 2000-2016, where the average size of new-constructed dwellings have been 96 m2, which has increased the average size from 76 m2 to 81 m2 in Copenhagen, while the number of people pr dwelling is 1.96 people, thus Copenhageners utilise 41,3 m2 pr person in average (KK 2018 p.12; 17).

Accordingly, the occupation of m2/person is generally increasing in EU-member states, except for Sweden, and the wealthiest countries are already well-above the 30-35 m2/person, which are an estimation of the maximal m2 one person can occupy, to keep the global temperature rise within 1.5 degrees, with and without negative emissions, respectively (IEA 2021: Grubler 2018, see figure 2). While, people in Copenhagen live more sufficient than average Danish citizens, there is still room for improvements.

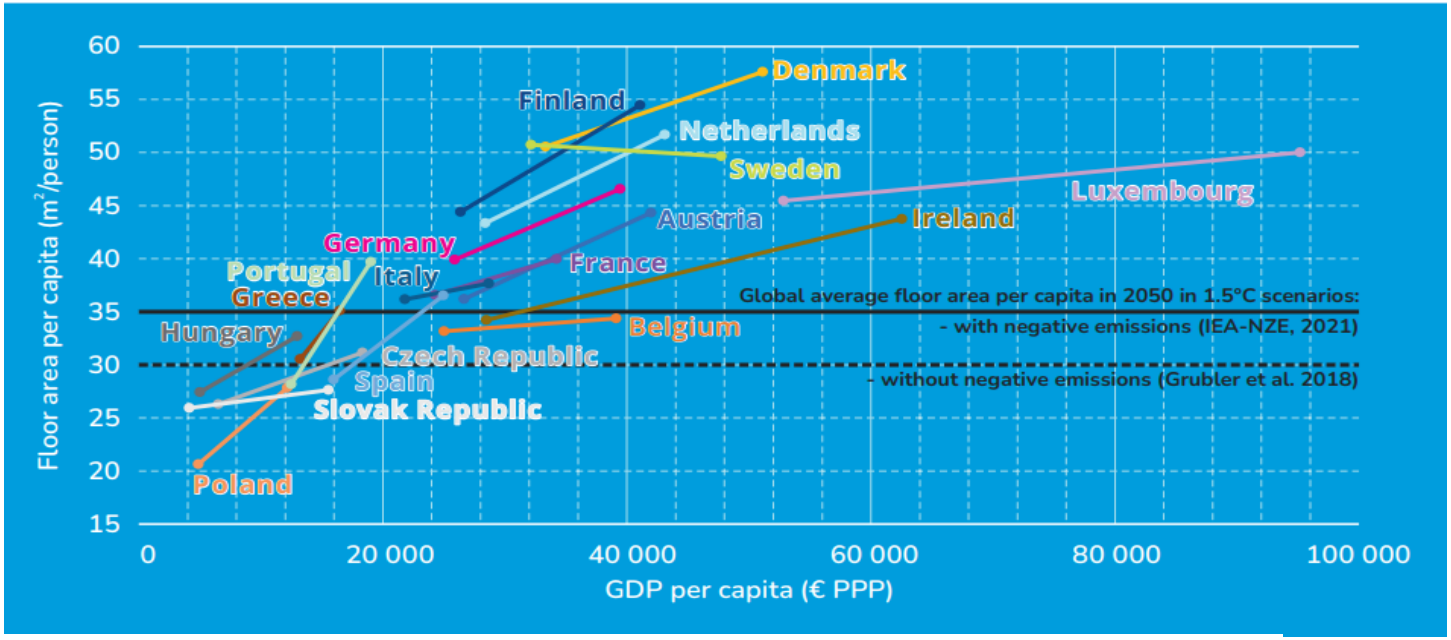


Figure 2. Showing average floor-area pr. capita as a function of GDP Accessed from Saheb 2021.

In turn, there are many singles in Copenhagen, out of the 307.843 dwellings in Copenhagen, 158.000 or 51% live in a dwelling alone (KK 2018; Videnscentret Bolius 2021). Further, in 2017, the Technical University of Denmark estimated that it was possible to establish 10,000 new dwellings to house approx. 22,000 Copenhageners within existing roof-top-storeys (Rådet for grøn omstilling, n.d.) which suggest a potential of improving possibilities for more shared living and space optimisations.

However, according to Saheb 2021 there is a lack of policies related to sufficiency-measures on an EU-level, and without these measures it will be difficult if not impossible to reach the 1.5-degree goal of the Paris-agreement. The overall claim from Saheb is that efficiency-measures cannot lead to a sustainable built environment alone. Rather, **policy-measures and actions** should be based on what she calls the SER-framework, which compiles: Sufficiency, Efficiency and Renewables. In turn, Saheb plea how sufficiency should come first and within this paradigm it is important to make policies and concrete actions that can provide better opportunities for people to live more sufficient (Saheb 2021).

1.3 Elements that hamper acceleration of CE in the building sector

This section addresses some overall elements that hamper acceleration of circular measures in the building sector. To highlight some tangible insights about these elements, the following section departs in a panel-debate that took place on the conference, Building Green Copenhagen 2021 (Building Green 2021: appx. 10) and centred around the question:*" How can we implement more circular building-parts in the building-sector and who carries the responsibility?"* (Appx. 10).

The departure point of the debate relies on the notion that actors in the construction-sector are divided in highly specialised functions in which certain roles and tasks are executed. Subsequently, this leads to conservative construction-projects where it is largely the same methods and techniques which are applied from case to case and as a result, there is little room for implementing alternative measures.

Info-box 1. Info on the platform Building Green, the panel-participants and the organisations they represent.

Panel: Anders Lendager (Founder of Lendager Group), Mette Glavind (Dir. Technological Institute, TI), Martin Manthorpe (Dir. NCC), Michael H. Nielsen (former vice. dir. DI Byggeri).

Building Green is a platform that aims to share knowledge and experiences of sustainable solutions in the built environment, and every year is held a two-day conference in which actors from the building sector can join to share and discuss sustainable solutions (Ibid.)

Lendager Group consists of Lendager ARC, TCW & UP. TCW stands for "Lendager the circular way" and advises the building sector about circular potentials. UP is manufacturing building parts by reusing materials and components - UP has just merged with RE-PLASTIC and become the independent firm, a:gain that aims to make sustainable building components, housing and urban interior mainstream in real estate.

Technological Institute (TI) Supports businesses by providing specialised knowledge and opportunities for tests and experiments with new technologies. E.g., by helping businesses gain sound analysis about properties and performance of products.

NCC is one of the largest construction companies in the Nordic part of Europe, providing services including development of commercial construction, infrastructure projects, as well as asphalt and raw material extraction.

Dansk Industri is Denmark's largest workers and trade organisation.

The panel moderator describes how building projects often deviate from the sustainable ambitions e.g., due to budget-cuts along the project-phases, and thereby asks the panel:

> "**How should collaboration work in the value chain** and **how should construction-projects be organised** so that the ambition **to incorporate more circular materials in both new construction and renovation** can be met? Here, consider - guarantees of lifespan, rules and requirements, etc. (34:00 appx. 10).

Early engagement

All panel participants emphasise how early engagement of all actors in a building project is one of the most essential aspects, when the ambition for a project, is anything above business as usual, as Martin Manthorpe (NCC) suggests; *"if contractors are brought in late in the process, focus will only be competition on the price with no notion of innovative measures related to circularity"* (35:00 appx. 10). This position met support in the rest of the panel, and followingly they broadened the scope around the topic of collaboration with aspects like responsibility & liability (risks), mistrust among actors in the building sector, costs, and changes in the value chain.

Mistrust among actors

The participant, Michael H. Nielsen (former dir. of Danish Industry) claims that strategic partnerships can be the answer to a lot of the barriers related to the building sectors' lack of innovation.

He believes this because **the building sector is characterised by a lot of mistrust among different parties, and as a result, many cases end up in lawsuits about which party is to blame for contract-breaches e.g., added costs, delays and an overall lower quality than agreed** (35:40 appx. 10). The remaining two participants Anders Lendager and Mette Glavind both agree with this position. Further, Mette Glavind supplements by suggesting that investments in the early stages (pre-projecting) needs to be more in focus and this needs to be understood by all parties in the sector (36:35 appx. 10).

Economic considerations and risk mitigation

Finally, Anders Lendager turns his attention to the fact that investors normally require an interest-rate of 10% on real estate projects - a very large sum that does not add anything to the actual building-project, and in turn, quality for the users. As a further consequence, the margins of income for the remaining part of the value-chain are a lot less. As he further exemplifies: *"A contractor like NCC has an interest-rate of 1-2% if they do really well. And, when advisory-firms and architects are pressured on time and income as well, this creates a core-premise in which no one has the incentive to risk anything."* (38:00 appx. 10).

Regarding this statement, a person from the audience asks; *how he thinks this problematic core-premise concerning the large interest-rates of investors can be dealt with*

Lendager replies that, as a new tendency, many international investors have lower interest-rates, and they can see the benefits of investing in quality construction projects. However, on a different note, Lendager believes it is important to be interested in being a part of different areas of the value-chain, because if you have a strong position about how the sector should develop, you need to be invested in developing areas of the value chain, and one way to do this, is by creating a mandate to do so (41:00 appx. 10).

Setup of the value-chain

Thus, the important thing is not which part of the value-chain you belong to, but rather, moving towards a more influential role, to be a part of bringing new solutions forward. Further, Lendager emphasises how the entire setup in the value-chain needs to operate differently.

Lendagers notion points to the fact that a circular setup cannot happen in the siloes in which many actors of the building sector remain, because you cannot make *"circular products"* without a circular value chain, and this requires a new setup.

On the one hand, goals and ambitions and the individual agency of a business can be influential in terms of bringing new ideas and solutions to the fore. Yet, for this to be brought further, it needs to be adopted in a collaborative effort across the value-chain of the building sector, e.g., through strategic partnerships through which ideas and ambitions fostered in individual agencies can become part of common goals and be materialised in construction projects.

Mette Glavind, likewise, emphasises how all parts of the value-chain have been essential when they have been part of innovative steps that led to something substantial. (43:20 appx. 10).

1.4 Point of departure

This section will scope the focus of this report by describing the legal base of the building sector regarding how this corresponds with accelerating circular measures in renovation projects. Further, the section provides background info relating to ownership of dwellings in CPH and the CE-measures being taken for different parts of the building-mass in Copenhagen.

Share of ownership

There are 307.843 dwellings in Copenhagen, 96% of these are installed in multi-apartment buildings, equivalent to 295.529 dwellings. The share of ownership, calculated by dwellings, are followingly: 30% cooperative housing (the ownership of the property is shared between tenants), 20% common cooperative housing[1] (owned by cooperative housing companies), 20% private ownership, 29% private rentals (owned by private rental companies) and 1% dwellings are government-owned (KK 2018; Transportministeriet 2019).

Legislation

The common base for all property-constructions is the *building act* (Bygningsreglementet 2018). Currently, there are no requirements or incentives to implement circular measures within the act (Horten 2015), such as e.g., designing for disassembly, using secondary parts, designing for multiuse and durability or materials. In 2023 there will however be requirements for a maximum 12kg CO2/m2 of the construction for buildings of 1000 m2 or more and in 2025 the requirement will also cover smaller buildings and the CO2-requirements will be tightened gradually toward 2030 (Miljøministeriet 2021).

[1] Common corporate housing-companies are non-profit organisations that offer rental-dwellings, not to be confused with cooperative housing associations, in which the tenants own a share of the property.

Besides the CO2-requirement there has also been installed a *voluntary sustainability-scheme* in the Danish building act entailing a broader set of requirements, accordingly:

- Life cycle assessment
- Resource use on the construction site
- Total cost of ownership - costs for construction, operation and maintenance
- Operation and maintenance plan for maintaining the indoor climate
- Documentation of problematic substances
- Degassing to the indoor climate
- Detailed demonstration of the daylight level
- Noise from ventilation systems in homes
- Room acoustics in homes

In the government's strategy for sustainable buildings, it is emphasised that future legislation will be founded on experiences and insight from building projects where this scheme has been followed. (Indenrigs- & boligministeriet 2021). This may create an incentive for the building-sector, namely contractors, to begin implementing these measures before it becomes legislation, due to the competition-advantage of being ahead of future legislation, and because sustainable branding is a competition-measure (Building Green 2021).

Common cooperative housing as a driver for sustainable initiatives in renovation

The common cooperative housing-companies want to be a key driver of scaling circular building-practices (Building Green EU 2021). Denmark's largest common cooperative rental company KAB have already started to reuse materials within their residential areas to construct interior like benched and sheds. However, KAB has also initiated four working-groups one focused on developing a storage facility where building-parts can be bought or traded, another investigating how sustainable building-practices can be economically beneficial, e.g., by approaching the economic perspective regarding lifecycle costs and finally they aim to make concrete guidelines to secure sustainable outcomes of their properties (ibid.) Furthermore, In Denmark's national strategy for sustainable buildings, common cooperative rental-companies (CCRC) are mentioned as a key actor to accelerate development of digitalization in the sector (Indenrigs- & boligministeriet 2021 p. 51). This is an important step to recirculating more, as digital tools can make it easier to identify circular solutions. The self-owning organisation, Landsbyggefonden in which distribute and disburse the funds to maintain the common cooperative properties, will begin to collect data on the condition of the properties to strengthen the CCRCs maintenance-plans, this can have great influence on the lifespan of existing materials and can prevent the need for replacements (ibid.). Further the Danish government, with most parties, has agreed to allocate 30,2 billion for *"green renovations"* to CCRCs in the period 2021-2026 (Transportministeriet, 2021). Followingly, this will affect a large share of dwellings nationally, as CCRP's accounts for around 20% of the entire building mass (BL n.d.). Currently 72.000 dwellings have been approved to be renovated. Thus, all projects will go through a two-phased screening-process to identify green measures to implement in the concrete renovations of the properties. Further, the agreement brings a significant change to the eligibility criteria in which CCRPs must meet to be considered for a renovation. Instead of solely prioritising renovation-needs according to "*necessity due to dilapidation"*, these criteria will, further on, go hand in hand with so called green measures (Transportministeriet, 2021). Accordingly, the estimation is that green measures will be incorporated in 85-90% of renovations going forward (Ibid.).

2. Introducing the Building Renewal Unit

Thus, the remaining part of this report will investigate possibilities to push for something more ambitious than what the legal framework prescribes. This investigation takes departure in The Building Renewal Unit (BRU), an agent in the Municipality of Copenhagen that co-fund renovation of privately-owned multi-apartment buildings and makes development-projects that aims to add new possibilities into the practices of renovating buildings. As Architect in BRU, Dennis Nørup Knudsen puts it:

> [...] "We try to return buildings to their original aesthetical look [...] at the same time we run demonstration projects that are much more specifically about uncovering untested measures, new technologies, challenging legislation and whatever it may be" (4:50 appx. 2).

Followingly, the next section introduces The Building Renewal Unit (BRU) as the overall case of this report and frames the purpose of the study by describing how BRU operates and the measures BRU currently applies to push circular outcomes through the co-funded renovation-projects.

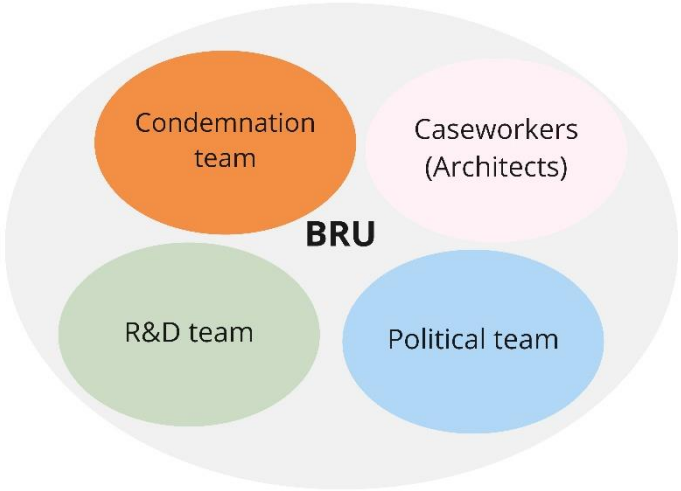
The Building Renewal Unit is a part of MCPH's Urban Renewal Operations that also consists of the **Integrated Neighbourhood Renewal Unit, The Courtyard Renewal Unit**. All three units are funded within the municipal budget, which is normally quite consistent (appx 16).

However, the funds are split between the three units, therefore they can vary according to how the city council decides to allocate resources. In practice, resource-allocation depends on the expected size of activities, which is decided in relation to the units' expositions of the inherent year cf. Byfornyelsesloven, 3 §8; 4 §21. Accordingly, the Building Renewal Unit normally manages 100 million a year and allocate the funds through Building Renewal-grants for the applicants that correspond best with BRU's eligibility criteria (appx 16). These criteria are based in the act of urban renewal cf., Byfornyelsesloven chap. 3; 4, and on measures in which BRU internally agrees to put extra focus on, for instance, circular practices or integration of renewable energy.

These are generally focused on facilitating measures that correspond to MCPH's political goals for sustainable transition. Accordingly, MCHP's goal to become climate-neutral in 2025, which for building-renewal-projects correspond to facilitating measures that can reduce energy-consumption by 20-30% on the properties, depending on the preservation value. And further, to support the goal of installing solar-cells enough to produce what equals 1% of the electricity-use within the municipality (KK 2016 p. 11:13). Moreover, to facilitate measures that support MCPH's goal: "*to go from considering buildings for demolition and conversion to construction-waste to instead regard buildings as material banks"* as prescribed by the resource and waste management plan 2019-2024 - Circular Copenhagen (R24) (KK 2020a p. 32; KK 2020b). Furthermore, it is described in United Copenhagen (Fællesskab København): [**that**] *"the resources in the city's waste are utilized far better than today. Copenhagen must achieve this by drawing less on the planet's resources through sharing schemes, recycling, and a better framework for Copenhageners to contribute actively to the green transition."* (KK 2020b).

Subsequently, it is BRUs role to provide financial aid for dilapidated properties with significant technical and physical deficiencies and to help fulfil MCPH's political goals by working on concrete solutions to support the goals of MCPH.

The task of determining who gets funding is carried out by a team of architects, which are the caseworkers, this will be elaborated in the next section. Furthermore, BRU consists of a condemnation-team, a political team, and an R&D-team. The main function of the political team is to synchronise BRUs operation with the **technical and environmental committee** and **the city council**, in practice this revolves around making expositions for political approvals. For instance, when the caseworkers have finalised their task and picked the applicants to provide funding including comprehensive economic overview of renovation-works etc. The next step is to make the expenditure for political approval, which the political team does. The condemnation-team has a similar, yet different role than the caseworkers, their job is to make condemnation-cases of properties in MCPH where living conditions are very poor and inadequate for human occupation. Lastly, the R&D-team deviate from the rest, their focus is to lead development-projects that can accelerate developments of BRUs operation. Thus, the R&D-team works quite autonomously with this task since it is not directly attached to case-management processes. Hence, the funding for development-projects is not a part of BRU internal budget either but relies on external funding. Thus, the projects R&D produce should eventually lead to concrete elements that can strengthen the caseworkers' capacity to facilitate measures that can accelerate development of sustainable activities such as those prescribed in **R24** and **United Copenhagen** (appx 1-5).



Combined, these teams make the whole Building Renewal Unit (BRU). Followingly, the operation of BRU will be explained in further details in the next section.

2.1 Operation of the Building Renewal Unit

The Building Renewal Unit (BRU) works city-wide as an agent within the technical & environmental administration of MCPH by co-funding renovation of multi-apartment buildings, owned as private rental properties or by housing associations, by 25-50% through a grant-program. The amount of funding depends on the preservation value of the property, according to SAVE-criteria (Slots og Kulturstyrelsen n.d.). Properties of high preservation value can gain 33%, thus max. 125.000 DKK pr. apartment and those with low preservation value can gain 25%, max. 100.000 DKK pr apartment, while demo-projects can gain up to 50%, max. 150.000 pr. apartment (KK 2021a; KK n.d.a).

Thus, the premise upon which property-owners can gain funding is foremost focused on the level of deficiencies, hence, replacing or repairing derelict elements of the building, e.g., roofs and windows. Further, on preserving architectural heritage, alleviating noise, improving sanitation, and generally ensuring healthier housing, cf. Byfornyelsesloven, chap. 4 §21 pcs. 1, 2, 3 and municipalities can make requirements of how the renovation should be carried out, e.g., in the capacity of construction and environmental criteria cf., §25.

The building-renewal program runs for a 3-year period, except for demo-projects, which more likely run for 5 years (appx 16). Applicants are foremost prioritised according to installation deficiencies and the caseworkers assess every application according to the criteria and award the best fitting candidates until the budget is reached, thus, it is not, *first come, first served*, rather - *the worst come first.*

In accordance, the present eligibility criteria are:

- Properties that when renovated, significantly reduce energy needs, and contribute to the city's CO2-target. *BRU has concretised these criteria by requiring that properties must move up, two energy-labels, or reduce energy-consumption by 20%*.
- Properties where there is a lack of toilet, shower, or district heating installations.
- Properties built before 1960 that are significantly dilapidated.
- Properties that are exposed to road noise above 58 dB

- Demo-projects - *willingness to enter a demo-project is an advantage in terms of being provided, and by this even gaining up to **50% financial coverage** instead of the usual 25-33%.*

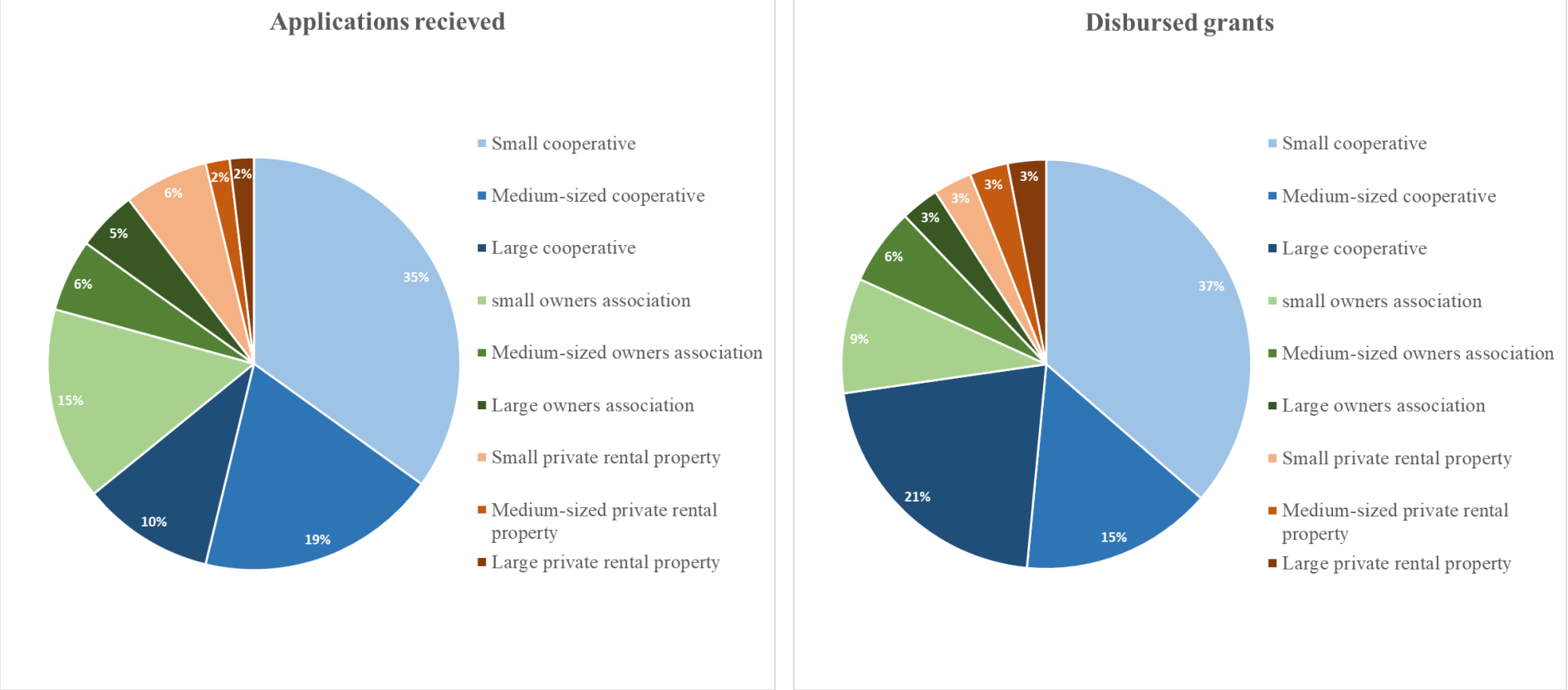
Presently, there are three different grants to apply: 1) **thorough renovation**, which concerns repairing or replacing large parts of the building, e.g., a roof. 2) **renovation to reduce the noise-level inside dwellings**, i.e., renovating or replacing windows 3) **lack of toilets and showers.** (KK 2021a).

Thorough renovation is the largest grant of the three in which about 100 million DKK is allocated each year and BRU normally receive 50-60 applications of which 10-20 receive funding, which equals about 1000 dwellings (appx 16). Thus, caseworkers pick the final candidates, and the city council makes the final approval. The two other two grants are smaller and comprise 40 million collectively, disposed on three years which BRU can disburse without any political approval and the application-turns are 2 times a year (appx 16).

The application is a two-phase process: the preliminary applications include a short outline describing elements that constitute the necessity for renovation. These are evaluated according to the eligibility criteria and the best suited candidates are invited to forward a qualified application. BRU provides funding for cooperative housing associations, private housing associations and private rental companies and there are no predisposed preferences, regarding ownership-form or size of the properties (KK 2021a; appx 16).

The following part focus specifically on the grant for **thorough renovation** and provides an overview of preliminary applications BRU has received, and grants disbursed in 2020 and 2021 by showing the distribution of cooperatives, owners associations and private rental properties.

Figure 3. Distribution of; Small **(≤40)**, medium-sized (**41-150**) and large (**151≤)** properties that has applied a grant [left side] been disbursed a grant [right side]



The figures shows that cooperatives have the largest share both in received applications and the grants disbursed, consecutively 64% and 73% The distribution of applications and disbursements are in general very similar, the biggest difference is 11% in large private rental.

However, this statistic is only based upon the applications of 2020 and 2021, only a snapshot of more than 30 years of building-renewal (55:20 appx 2. Thus, the caseworkers claim that it can vary, but in general they receive most applications from cooperatives and therefore it makes sense that most grants are disbursed to cooperatives (Appx 16).

2.2 Increased focus on sustainability measures

BRU has been sharpening the focus on sustainability in recent years, especially within demonstration-projects (demo-projects) where the purpose is to integrate new solutions in the renovations. There has for instance been projects about integrating solar cells in ways that does not blemish architectural qualities of the buildings and surroundings (Solar City Denmark n.d.), while other projects have been focused on creating better indoor climates with more light and air in the dwellings, e.g., the projects *"Klimakarréen"* and *"Living in Light"* (KK n.d.b; KK 2019 p. 18).

Furthermore, BRU has also been working on implementing the circular economy since 2019 and in this regard, Lendager Group[2] was hired to make a screening- & process tool in 2019 (appx. 5; 14; 15). The overall purpose was to use the screenings to show applicants and advisors the potential in, maintaining, reusing, or recycling existing building-parts, hoping that this would make them realise the importance of executing measures to realise circulation and most preferably restoration. Further, the process-tool was meant to become an integral part of the case-working process, however this has not been successfully implemented (20:00 appx. 2; 45:00 appx. 4).

Subsequently, the caseworkers describe how the process has never been practiced and the material-screening part of the tool has been used on some cases, but not led to any actions being taken on this account. However, the process was meant to follow the steps of the process-tool created by Lendager, cf. table 1 and see the info-box on the screening-tool (ibid.)

[2] Lendager Group consists of Lendager ARC, TCW & UP. TCW stands for "Lendager the circular way" and advises the building sector about implementing measures to reach circular potentials.

Info-box: screening-tool created by Lendager, based on appx. 14.

The screening-tool is designed to assess potentials of maintaining or repurposing the most common building-parts in a larger renovation-project and these are: roof-tiles, glass, and bricks and the tool is divided in three parts: **input, output**, and **communication**.

Input: the input-part requires filling out five categories: 1) one of the three building-parts 2) a description of this, e.g., the condition, where it is placed in the building 3) quantity 4) production-year 5) technical specifications, this can be a description on the details of the component, e.g., it is a two-layer-glass solid wood window. This description influences the kind of circular measure that is possible for the component.

Output: the output-part has three possible outcomes 1) **reuse** in which the component is applied for the same purpose as before 2) **upcycling** where the component e.g., becomes part of a product of a higher value than before and 3) **downcycling** the material enters a use-phase in which the component has a lower economical or material value than before. The component is put in one of the three categories according to how the input has been filled out.

Communication: the communication-page of the tool translate the output of each of the three components and the sum of all three in a pedagogical way, by relating the output to the CO2-emmisons and waste-production of an average Dane and how much of a typical 1-familie-house of 100 m2 one could build with the materials. 1) CO2-reduction and how many Danes this equal 2) waste-reduction and how many Danes' waste-production this equal and 3) how much of a 100 m2 house the materials can be converted to.
The reason for making the communication pedagogical like this, was to make it easy for the property-owners to understand the impact of applying the circular measures and by this make them interested in utilising these potentials.

Table 1. Internal BRU Process-tool to facilitate project management according to circularity, based on appx. 15.

Advisory meetings	Preliminary application	Qualified application	Political Processing	Political commitment	Tendering	Execution	Post-project
Phase 0	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**	**Phase 6**	**Phase 7**
Expectation reconciliation with advisors CE-Catalogue with inspiration. CE-section in the application form.	Ask specifically about CE-wishes in dialogue with applicants. CE-criteria in the final application. Prioritize consultants' experiences in driving a circular process.	Continues Expectation reconciliation with Advisors & prioritizing building-components with Residents. Examination & Assessment of materials & place-bound analysis by means of the screening-tool Prioritize applications that focus on circular solutions.	Factsheet with expected CE-effects (waste, CO2 & resource reductions) Presentation of the suggestions with politicians concerning the expected CE-effects. CE is incorporated as a political goal and criteria.	Dialog with technical experts concerning application and tendering. MCPH delivers tender appx. as inspiration for the applicants' allocation criterion & CE-criteria for the contractor to abide.	Evaluate whether the tender align with criteria formulated in phase 4. Make sure to involve contractors early in the process. Make decisions on storage for the dismantled materials. Put CE-criteria in the contract.	Communication about CE-initiatives across the building site Develop a CE-action plan. Data-collection & registration of material uses etc. for further documentation & impact-analysis	Debriefing about the process with all concerned actors Development of a CO2-accounting-scheme & input for MCPH's climate accounts. Development of a new inspirational catalogue for the applicants. Results are evaluated based on tendering & CE-goals

While the caseworkers believe in the idea of circulating building-parts is valid and something BRU should be involved in, they do not believe the market is mature for requiring specific actions that have to be followed by external advisors and applicants and performed by contractors (29:30 appx. 2).
Furthermore, BRU have not made their own definition of CE. However, based on the interviews, it appears that employees care about maintaining the original architectural style, and, maintaining the existing materials when this is deemed possible. Thus, one caseworker expressed that BRU does not follow any strategy or process to secure circular outcomes in the renovations but referred to MCPHs environmental criteria that must be followed in all municipal constructions (19:00 appx. 2; 40:30 appx. 5).

In turn, MCPH has just updated the environmental criteria for constructions and regarding renovation this entail compliance with the DGNB silver standard, Svanemærket or similar schemes if the municipal share of funding the project exceeds 20 million DKK, or in case the renovation is **extensive**. An extensive renovation comprises at least renewal of 50% of the climate screen, and one complete change of the technical components (ventilation, heating central etc.) or at least 25% of the climate screen and two complete changes of the technical components. (KK n.d.). All construction that does not correspond to the above, must follow MCPH's own scheme for environmental criterion, **the MBA**, which has also been updated. Thus, BRU does not deposit 20 million on a single property, thus facilitation of the projects is managed in accordance with the MBA cf., appx. 11; table 2. The specific requirements of the criteria are inspired by DGNB-criteria and has been adapted to be used in BRU-cases. The list below provides an overview of the **seven criteria** that relate to CE in **thorough renovations**, and table 2 provides an overview of, how the criteria relate to BRUs three grants – notably, there are 12 criteria in total, cf. appx 11.

DGNB.Pro 1.5: 10-year operation and maintenance plan, Guidance on maintenance, inspection, and operation. Update of drawings, as performed for the building-parts that are included in projects.

MCPH.ENV 1: The properties' energy label needs to be improved: Properties with energy labels B, C and D must be improved one step, energy label E must be improved to C (two steps), and label F must be improved to D (two steps) and energy label G must be improved to D (three steps). In the implementation of the requirement, profitability is considered, whether the building part is ready for renovation and if they are worthy of preservation.

DGNB.ENV 1.1: Assessment of options in building materials and value of LCA calculation. Copy of life cycle assessment between 1-3 alternative building materials. Use at least one product with specific environmental product declaration (EPD) in a project.

DGNB.ENV 1.2: Contains a list of 45 substances that cannot be applied in the renovations, cf., appx 11.

DGNB.ENV 1.3: Wood shall be certified FSC or PEFC or equivalent that follows rules laid down in or the wood is recycled wood with a declaration of previous use / origin or manufacturer declaration for that a wood product is made from recycled wood.

DGNB.ENV 1.6: Use the **CE-tool prescribed by BRU** to identify potentials for repurposing building-parts.

DGNB.PRO 2.1: A concept shall be formulated for handling and reducing waste on the construction site in the tender. Set up containers with marking of the waste fractions. Staff on the construction site is informed about the concept for handling and reducing waste on the construction site. Control / review of the implemented work is carried out in a concept for handling and reducing waste on the construction site. Copy of clarification for purity test of reused/recycled materials.

These criteria can be related to Bocken 2020's five circular criteria, that comprise:

- **Regenerate** is about using clean materials and renewable energy-sources in a way that correspond to environmentally sustainable activities.
- **Narrow** refers to a strategy in which fewer materials and less energy are spent for the design, production, and operational phase of the building (ibid.).
- **Slow** refers to keeping materials in use for as long as possible, which can for instance be supported by designing things for durability and reparability.
- **Close** refers to the process where materials, products and parts are accessed within the technical circle by reuse or recycling (ibid.). This can for instance be achieved by designing construction-systems or components for disassembly and in BRUs case it will often revolve around windows and roofs.
- **Inform** refers to using data that makes it possible to make informed decisions about all aspects of a products lifecycle, regarding the different processes happening within loops of the biological and technical circles. E.g., using EPD's to make decisions on material-use or using maintenance-plans to secure preventive repair to prolong lifespan of building-parts.

Table 2. Environmental criteria of the MBA: by relevance of the three grants. This table is a translated version of one that can be found in appx. 11 p. 68.

MCPHs own Environmental Criteria, related to the five circular strategies (Bocken 2020)	Measure:	**Grant for sanitation betterments** (lack of shower or toilet in the dwelling)	**Grant for renovation to reduce noise pollution in dwellings**	**Grant for thorough renovation**
Pro 1.5, Slow, narrow	Operation and maintenance plan	Often not relevant	Relevant	Relevant
MCPH.ENV 1, narrow	Energy optimisation	Relevant	Relevant	Relevant
DGNB.ENV 1.1, inform, narrow	Life Cycle Assessment	Often not relevant	Often not relevant	Relevant
DGNB.ENV 1.2, regenerate	Limits on toxic contents	Relevant	Relevant	Relevant
DGNB.ENV 1.3, regenerate	Responsible resource extraction of wood	Often not relevant	Relevant	Relevant
DGNB.TEC 1.6, Close, Slow, Narrow	Circular Economy – Disassembly and repurposing	Often not relevant	Relevant	Relevant
DGNB.PRO 2.1, regenerate, slow, narrow, close, inform	Construction waste management on site	Often not relevant	Relevant	Relevant

Thus, the criteria of the MBA, is according to BRUs own table, especially relevant in thorough- and noise-related renovations, while for sanitation betterments only, limits on toxic content and energy-optimisation are often relevant, which support **narrow & regenerate** cf. table 2. Thus, in

thorough renovations, requirements for LCA and 10-year maintenance-plans can support circular outcomes related to the circular strategies **slow, inform, narrow, regenerate**: Maintenance-plans can help secure preventive maintenance which can increase lifespan. While LCA can **inform** and lead to a cleaner and more environmentally sustainable choice where e.g., less energy and materials has been used in production compared to alternatives. Further, waste management on site can support **close** by increasing possibilities for repurposing materials by reuse or recycling.

Subsequently, BRU are facilitating measures that potentially can secure circular outcomes with the MBA. However, most of these measures relate to new building-parts replacing the existing ones. However, there is one criterion relating to repurposing the existing building-parts, which pre-scribe that BRU facilitate a tool that can be applied to realise this task. Thus, according to the employees of BRU the tool to do this, is currently the process- & screening-tool created by Lendager Group in 2019 (appx. 11 p. 76; appx 16 p. 151). Thus, another significant change in the MBA, is the fact that advisors are obligated to deliver proof to show that criteria of the MBA has been followed, whereas before, they merely signed a sworn statement (ibid).

Summary

Renovation of the existing building mass is a crucial element on the development-path to sustainable cities because it can fulfil needs of dwellings by less consumption and CO2 emitted to the atmosphere opposed to new constructions. Thus, there are untapped potentials in utilising materials and components of the existing building mass for new use phases in a circular economy. However, there are several elements hampering developments of these potentials, e.g., mistrust among actors in the and lack of collaborative efforts across professions sector cf. 1.3.

Furthermore, the legal framework does not provide support or incentive for the building-sector to tap into the potentials of CE. However, there may be significant progress soon because common cooperative rental-companies, that manage 20% of Danish dwellings, seem to have favourable conditions to fulfil ambitions of accelerating circular measures in renovation, due to the strong organisational structure and the immense financial backing of 30.2 bio. DKK. In turn, other initiatives seem to be necessary for the remaining 80% private properties, 79% in CPH. Subsequently, the Building Renewal Unit (BRU) in MCPH are in the process of incorporating CE as a part of their operation. So far it has gotten to cautious experimentation with a screening-tool and a process-tool that has not been deemed usable in the case-working process. Thus, in the updated version of MCPHs environmental criteria for construction, the MBA, caseworkers are prescribed to facilitate a tool that can assess potentials for maintaining, reusing, or recycling building-parts in the forthcoming operation of BRU. Furthermore, BRU are setting out to make a new strategy for the unit in 2022, and it would only be sensible to incorporate guidelines that can act as a common foundation regarding, how the Building Renewal Unit can facilitate measures to accelerate developments of CE within renovation-practices. This leads to the following problem formulation:

Problem formulation

How can the Building Renewal Unit in the Municipality of Copenhagen facilitate measures to accelerate development of the circular economy in renovations?

Research questions

1) **How do external advisors and the employees in BRU perceive BRUs role in terms of accelerating development of the circular economy through building renovations?**
2) **How can the Building Renewal Unit accelerate development of circular economy within the legal and organisational framework that applies to the unit?**
3) **How can the Building Renewal Unit improve their capacity to facilitate circular measures in the renovation-projects?**
4) **What challenges and opportunities does the Building Renewal Unit have in regard to facilitating measures that can accelerate development of circular economy through building renovations?**

3. Theoretical framework

The theoretical framework of transition theory, namely the Multi-Level Perspective (MLP) and Strategic Niche Management (SNM), supplemented with concepts of governance and circular strategies, to provide an understanding of different elements that can be operationalised to further the circular practices in renovations. MLP is introduced to lay down the ontological understanding within this branch of transition theory and to connect the subject-matter of BRU as a change agent that can accelerate development of CE in renovation-practices. Thus, MLP is limited to explaining transitions and does not prescribe operational concepts (EEA p. 62). Thus, as an extension in the same ontology, SNM is introduced to concretise strategic measures BRU can use to take part in the transition-steps.

3.1 The Multilevel perspective

The Multilevel Perspective (MLP) is a middle range theory that is commonly used to describe how transitions can come about in socio-technical systems and the theory builds on the three concepts: **landscapes, regimes, and niches**, cf. figure 3.

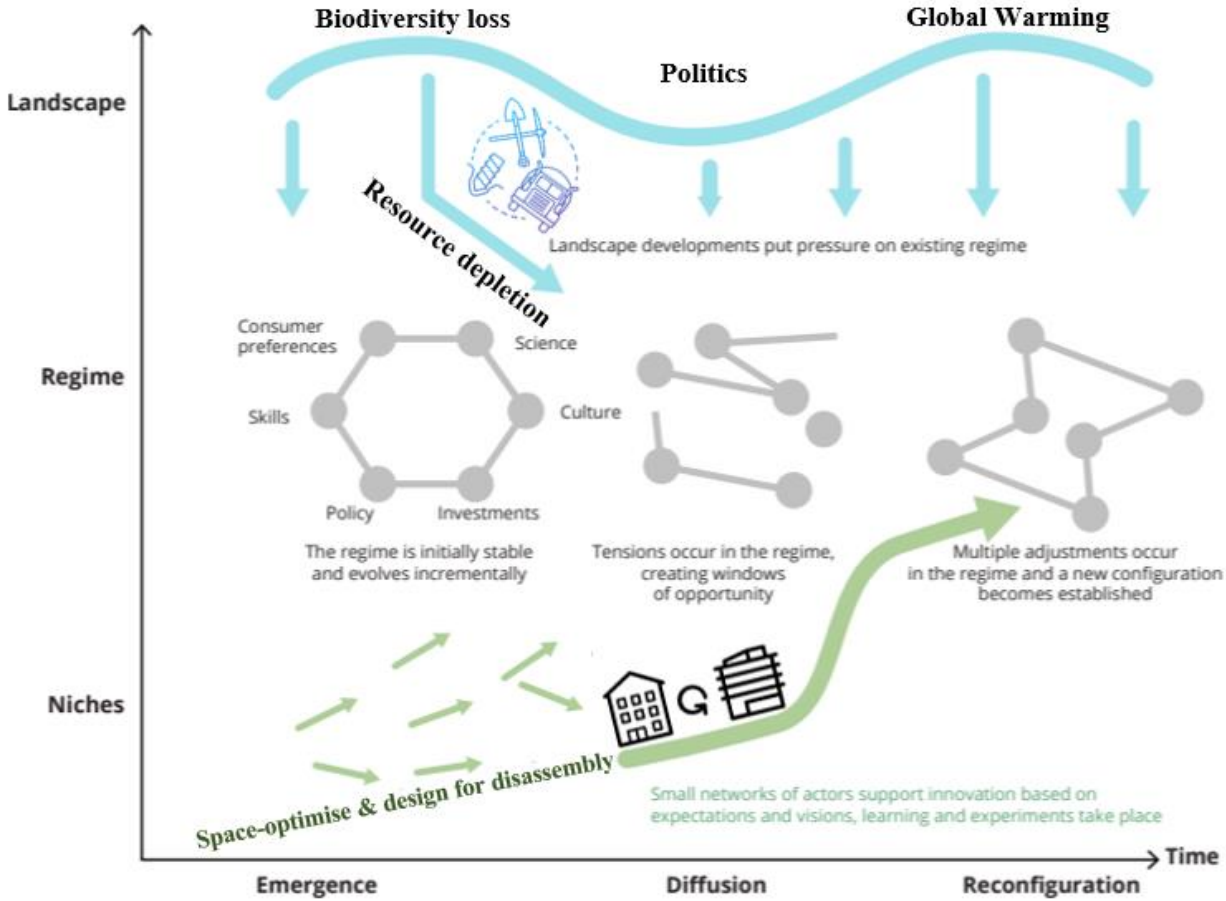


Figure 4. Illustration of MLP in relation to renovation. Own production based on EEA 2017.

The claim of MLP is that elements of society support existing regimes which secures stability within the system. Thus, at the same time it creates less than ideal conditions for radical innovation to gain momentum and become an elemental part of the system that upholds society (Geels 2002; Rip and Kemp 1998; See figure 4).
As conditions within the landscape change, the internal dynamics of regimes develop incrementally and take small turns to comply with the needs of society, and thereby it remains stable. If the regime however fails to adapt, it will become weaker and open **a window of opportunity** for **emergence, diffusion** which can lead to **reconfiguration** to a new regime (Bertolini 2017, p. 132). Subsequently, Bertolini 2017 suggests that interactions between regimes and niches are largely political plays, yet politics and the role of power is not explicitly explained as a feature within MLP. However, power and politics is a core element in terms of understanding the reality in which societal transitions can occur (Bertolini 2017, p. 132).

Performing power to accelerate developments that changes conventions within a current selection environment can be done in many ways. Thus, a classical way to perform political power is through direct enforcement by, taxes, regulation and rules that apply for citizens and companies defined as **command and control** (EEA 2017 p. 62; Christensen 2021). However, at city level the power to govern through authority is limited, and therefore other measures can be utilised instead. Municipal departments can for instance focus on how best to govern its own assets within their legal mandate to boost their influence as change agents (Christensen 2021). Further, influence can also be strengthened by **governing through enablement**. This can for instance be done, by facilitating collaborative activities both in formal and informal partnerships, e.g., strategic partnerships between governance bodies, companies, and citizens (Ibid).

The regime of the construction sector largely operates according to a linear approach where take-make- & dispose dictates the life cycle of building-parts. According to Miljøstyrelsen 2020, 52% of the materials in the Danish building sector are recovered and commonly applied as road-fill, noise abatement walls, 7% is incinerated and 5% is disposed (Miljøstyrelsen 2020). Further 36% is recycled, which is an important element of the circular economy to close material loops when direct reuse is not an option. Thus, recycling has become part of the norm in the construction-

industry and is arguably part of the regime and in the case of building-parts, restoration and direct reuse has a smaller climate impact because the production phase is cut out (SBI 2019; Rambøll 2020).

However, this report is concerned with, how BRU can facilitate measures to accelerate development of circular outcomes in renovations. In this notion BRU should empower novelties that secure more sufficient utilisation of the existing building-stock in Copenhagen. In turn, this could for instance be done by supporting the niche-practices within space-optimisation and design for disassembly, cf. figure 4. Thus, space-optimisation of existing properties could be realised by changing layouts to make ideal conditions for shared living or multifunctional use of spaces. This can for instance be done, by utilising roof-top-storeys, which there are already examples of in Copenhagen. The picture below shows an example of this, where three apartments have been installed in an un-utilised attic-space.

Retrieved from, Rådet for grøn omstilling (n.d. p. 31)

Regarding design for disassembly this could be realised by installing new construction-systems or components that are dismantlable. For instance, a roof-top construction that is assembled without nails, but by reversible joints instead, and on a component level, it could be a window in which individual part can be disassembled and repaired, reused, or recycled. In turn, measures within space-optimisation and design for disassembly complies with the circular strategies, narrow, slow, and close, cf. 2.2 since less materials will be used when apartments are installed in existing properties. Further, regarding design for disassembly components are easier to maintain when they are dismantlable and possible to reuse for different purposes in the future.

In the following section, strategic niche management will be introduced to provide some a prescriptive framework upon which a group of actors can actively empower novelties such as design for disassembly and space-optimisation.

3.2 Strategic niche management

SNM comprises three concepts; **shielding, nurturing, and empowering**, which according to Smith & Raven 2012 can be applied to foster strategic processes aimed at strengthening specific developments to go from being a niche, to becoming part of a new regime.

Thus, the claim of SNM is that the three concepts can be operationalised within the evolutionary logic of MLP by following a strategy to either be adopted or alter the current regime. Thus, either developing a method or technology that contests or follows conventions of socio-technical elements within the selection environment, where performance and competition are defined by the current elements that keeps a regime stable (EEA 2017). To operationalise a strategic process to foster a niche to become an integral element of a stable regime, the following strategies can be applied.

Shielding the niche is done by facilitating protective spaces to create an opportunity to experience the niche perform in a less competitive environment, which can be performed in a passive or active way. The active form could for instance entail subsidising demonstration-projects, whereas the passive form refers to idealistic and dedicated actors that wish to do something beyond business as usual, e.g., frontrunners that restore products many would have disposed of, or who apply reused materials in constructions (Smith and Raven 2012 p. 1028).

Nurturing refers to processes that improve the performance of niches by fostering socio-technical network capacities, by for instance creating a space where common goals, learning and reconciliation of expectations can happen continuously. An example could be strategic partnerships, where actors of different professions and backgrounds cooperate around a common goal to nurture one or more specific novelties.

Empowering comprises two strategies that can be applied to empower a niche, namely, **fit & conform** (F&C) and **stretch & transform** (S&T). The latter S&T is about creating changes within the current selection environment. Thus, it is about creating tensions that can lead to diffusion of the sociotechnical elements that makes the regime stable. This diffusion creates a **window of opportunity** to push the regime out of equilibrium. In the end, the tension will either be contested and dwell down and the regime will remain in the original form, or a new configuration will eventually stabilise and thus the emergence of a different regime (cf. figure 4).

Contrary to this, the **fit & conform** strategy relates to innovations that comply with existing regimes, by inducing incremental changes that fit into the mainstream selection environment. An example of F&C could be the practises of recycling materials, since this does not require any radical changes and fits into the current regime of the building sector, e.g., window-glasses that are recycled in the production of glass wool (Saint-Gobain n.d.) Thus, BRU already empower measures relating to F&C by for instance requiring that building-waste is sorted in fractions and use of clean materials by prohibiting toxic contents cf. the MBA; 2.2.

The ‘S&T’ strategy follows an opposite stance by institutionalising protective spaces where radical changes can be empowered by e.g., experiments, networking, and learning (Ibid). Both the S&T and F&C strategy can be operationalised to empower measures within CE.

However, this report focusses on the **Stretch and Transform** strategy and niche-practises like space-optimisation and design for disassembly.

4. Methodology

4.1 Empirical considerations

The research of this rapport has been conducted according to a problem-oriented and pragmatic approach in which the problem formulation and research questions has foremost been based on empirics (Holgaard et al., 2014). Thus, I have iterated and refined the problem formulation and research questions during the research. However, the subject-matter of the case has been BRUs capacity to secure circular outcomes in the renovations they co-fund and the processes within this. Thus, the theoretical perspective of the report has also inspired the research questions, based on the assumption that BRU can change their operation to enhance capacities and secure circular outcomes. Thus, in this perspective MLP and SNM has been help conceptualise the reality of BRU acting as a change agent for this cause, which leans towards an abductive approach (Dubois 2002). Further, I argue that the report is based on an auto-ethnographic study, because the case I have been studying, has also been my workplace for two years (Adler 1987).

During the study I have been situated in BRUs open plan office, where I have conducted research and used my co-workers as sparring-partners, e.g., I could ask people for data and when necessary, discuss this data to make sure I understood the correct meaning of it. Thus, since I have been part of the environment in BRU for some time, I had full confidentiality, and easy access to interview the employees in the unit. Thus, it was also through my co-workers' recommendations that I had the opportunity to get in touch with external advisors and set up interviews with them. Followingly, they provided me with contacts of some highly experienced advisors, specialized in renewal of multi-apartment properties. In the perspective of the caseworkers, it was interesting that I made these inquires of how external advisors perceive BRU, since such insights can be used for learning purposes.

4.1.1 Limitations of the study

A limitation of the project is the missing perspective from property-owners who have been part of a finalised or ongoing building renewal-project. This dimension could have contributed with concrete perspectives and further qualified a discussion of what aspirations residents might have regarding the renovations, and how such elements can be used tactically in relation to facilitating measures to secure circular solutions.

4.2 Research design

The objective of this study has been to gain contextual and deep knowledge of BRU, and the subject matter of, how BRU can act as a change agent that can facilitate measures to accelerate development of circular economy in renovation-practices c.f. 2.2. For this purpose, I have chosen to use case study as a research design, because it is suitable for diving deep into a subject matter and understand the deeper causes behind a problem (Flyvbjerg 2006 p. 230). Thus, the concept of a case is very broad, it can for instance be a person, a city, or an organisation. In this study BRU is considered an organisation even though it is a unit within a bigger organisation MCPH

4.3 Methods

Interviews

I conducted semi-structured interviews with two out of four **caseworkers**, one out of three from the **R&D-team**, one out of two from the **condem-nation-team** and the **head of BRU** in which represent the **political team**. Regarding the political team, I could also have interviewed the two employees that takes care of the day-to-day business regarding political services. Thus, I interviewed the head of BRU to get insights on his perspective of how the unit should evolve. In general, my reason for interviewing members of each team has been to create a holistic picture of how employees of different functions in BRU, perceive the role of BRU, and especially concerning the perspective of accelerating development of CE. Transcripts of these five interviews can be found in appx. 1-5.

I have also used four interviews conducted by an intern in BRU, these were supposed to be focused specifically on the screening-tool. However, a lot of the answers revolved around processes. Thus, the caseworkers could not address the screening tool, without talking about the procedural practices it was supposed to be operationalised within. I knew the caseworkers was not using the process & screening-tool and it was relevant for me to utilise these insights. Moreover, it made it possible for me to keep the focus of my interviews broader to gain more general insights about what the employees thought and about BRUs role as drivers of development within circular renovation-practices.

I divided the interview in five phases, the first phase was to introduce my intention with the interview, in phase two I wanted the respondent to reflect upon BRUs role, first in general, e.g., why BRUs work is important, and then more specifically the role of creating developments to make Copenhagen a better city, green transition etc. Phase three delved into the perspective of CE, in which the question revolved around how BRU could make a difference concerning development of CE-practices and if BRU had any special competencies in this regard. In Phase four I wanted the respondent to reflect on visons and possibilities for BRU to accelerate these efforts. Finally, phase five focused on limitations of facilitating measures regarding CE.

Further, I interviewed four external advisors from different firms, to gain an outside perspective of BRU, cf. appx. 5-9. The procedure was similar to the five internal interviews I went through different phases. First, I introduce the agenda, by introducing myself as a student of sustainable development of cities and my special interest in CE. To make it more concrete I had brought pictures of Ellen MacArthur's Butterfly diagram, cf. 1. Next, I asked questions about the advisors' role and how they perceived the purpose of BRU. Next phase focused on BRUs purpose and processes, e.g., whether the advisors noticed any special premises for the renovations, like goals or agendas addressed by BRU. Then, I asked about the applicants, e.g., what they usually care about, and what can get them to enter a demo-project. Last phase delved into, whether the advisors could see limitations in terms of BRU accelerating development of measures to increase restoration and reuse of building-parts within the renewals and lastly, what the advisors thought BRU could do differently.

Except the first two interviews, cf., appx. 2 & 4, all transcripts are rough, I executed these transcripts by first listening to the recording to scribble down the time and a brief note when something I thought interesting was mentioned, and then transcribed these pieces of information in detail.

Field notes

Making notes has mainly been something I have done to remember important aspects, while most of the primary empirics brought forth in this report has been recorded on sound and later transcribed. Thus, fields notes have been important, because it made it possible for me to trace back in my notes to look for the empirical evidence I wanted to refine further. While attending The Building Green Conference 2021 I recorded the talks and debates I attended, and I made notes on my phone. This gave me the opportunity to at a later point, look at the notes to identify if I wanted to transcribe some of the recordings, which became part of the introduction cf., 1.3, appx. 10.

Desk research

The desk research has been divided in two main parts. One has been to acquire knowledge on state-of-the-art scientific literature about circular economy and governance. The second, and most significant part of desk research have been retrieving and analysing formal BRU and MCPH documents to present the operation of BRU, cf. 2. Within this I have also processed data on received applications and disbursed grants to make an overview of the properties BRU provide grants to. Thus, for time related reasons, less effort has been put into literature search. Hence, most of the scientific literature has been accessed by going through previous research. For instance, scientific papers from the research in my last report, which was based on searches in the Scopus database in medio February 2021, by the search-words: Circular AND economy AND sustainability AND planning → 110 results. Here I picked out the papers I found most relevant and supplemented this by going through the bibliography to retrieve titles. Furthermore, my supervisors have provided me with relevant literature.

5. Analysis

This chapter provides comparative analysis based on responses from BRU and the external advisors. Thus, the analysis aims to investigate: 1) how BRU and external advisors perceive BRUs role in relation to accelerating development of circular economy 2) how BRU can facilitate CE within the legal and organisational framework that applies to the unit, and 3) how BRU can improve their capacities to facilitate circular measures. Following this, chapter 6, will provide a discussion based on the insights made throughout the analysis and this aims to delve into the challenges and opportunities BRU have if they decide to improve their capacity to facilitate circular measures regarding niche-practices of space optimisation and design for disassembly.

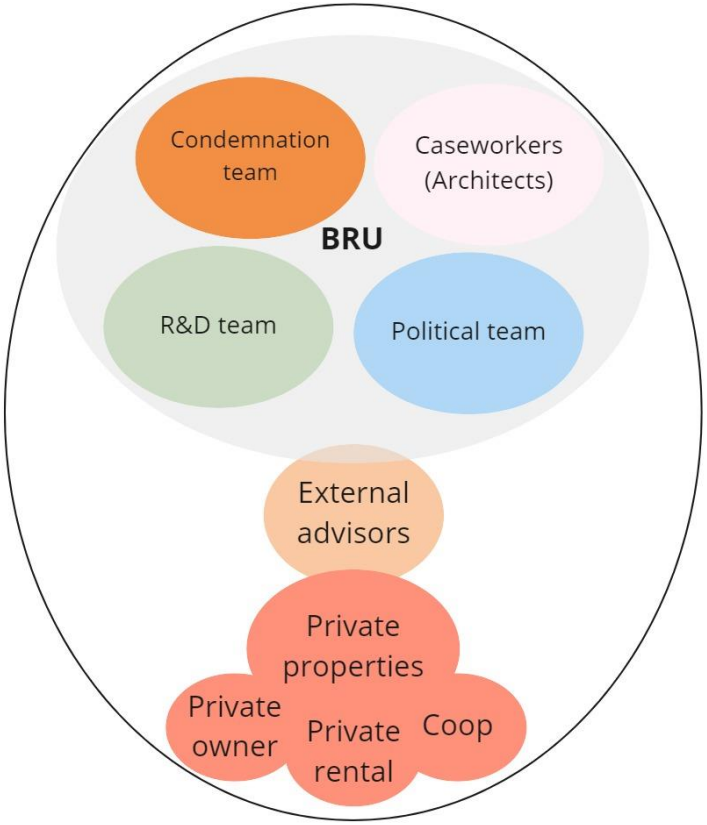


Figure 5. organizational diagram of BRU, plus advisors and property-owners

Hence, the first section of the analysis answers the question: **How do external advisors and the employees in BRU perceive BRUs role in terms of accelerating development of the circular economy through building renovations?**

Both employees and external advisors, agrees to the fact that BRU should facilitate measures that can lead to increased circularity when they co-finance renovations (44:00 appx. 1; 20:30 appx. 2; 1:10:20 appx. 3; 23:00 appx. 4; 1:02 appx. 5; 35:40 appx. 6; 36:20 appx. 7; 15:30 appx. 9; 24:00 appx. 8) However, no one believes they have the answers, concerning how to best facilitate these measures. However, the advisors expressed how BRU should get their process in order before they can start facilitating innovative measures. In turn, the advisors had all experienced processes in which either; major changes had suddenly emerged late in the process, requirements fostering dilemmas, because it was impossible to abide by one and the other, e.g., living up to both aesthetical and technical requirements, or that BRU could not follow through on their own initiatives (08:00 appx. 6; 58:30 appx. 7; 12:00 appx. 8; 16:00 appx. 9), e.g., one advisor provided an example from a recent project with BRU:

> […] "it was the intention from the beginning that the old windows [of the building] should be repurposed, but it did not happen, because where were they supposed to be sent off to, there was no recipients. I think BRU could have clarified aspects like this in advance. There need to be clear agreements, instead of it being like; we are trying to get someone to do something" (16:00 appx. 9).

Subsequently, it seems that BRU could have more control of their processes and a clearer strategy that comprises CE before they can facilitate measures that can lead to circular outcomes (35:40 appx. 6; 36:20 appx. 7; 16:20 appx. 9). The focus of this analysis is to identify the potentials of improving BRUs processes regarding facilitation of measures that can accelerate development of CE. Thus, before going into the further analysis, BRU-employees and external advisors will be presented by tables 3 and 4.

Table 3. list of competencies of employees in the Building Renewal Unit. (Based on interviews appx. 1-5).

Name and title	**Function**	**Competencies**
Janus Christoffersen - Head of the Building Renewal Unit and part of the political team of BRU.	Secure that BRU is rightly staffed, has the required competencies and proper conditions to fulfil the purpose of the unit which in its core is: *keeping the condition of properties in MCPH equal to the general standard* (cf. 1.3, 1.3.1).	A leader that provides the needed space for operating in projects and tasks based on the competencies of the employees. Makes room for developing and broadening the scope of the unit within the legal frames of BRU's mandate.
Erik Dam - Team-leader of property-condemnation team	To make sure that properties with condemnable living conditions are rectified.	Thorough understanding of the policies and laws under which BRU operate.
Øystein Leonardsen - Senior consultant and part of the R&D team in BRU.	Support development and innovation in BRU	Ingenuity - has been a part of initiating several strategic partnerships to increase capacity building around subject matters of urban green transition.
Dennis Nørup Knudsen - Architect and caseworker on the BRU-funding	Making sure that funding is provided to the most suited candidates, according to the eligibility criteria.	Thorough understanding of buildings, structures, different building traditions. Part of the organization Cradle-people and has deep understanding of the circular economy both on a conceptual and practical level.
Søren Bjarnø - Architect and caseworker on the BRU-funding	Making sure that funding is provided to the most suited candidates, according to the eligibility criteria.	Has worked with renovation and restoration of buildings all through his career, starting as a carpenter and now several years as an architect and advisor in different private firms before BRU.

Table 4. External Advisors

Name & Firm	Function & Profession	Competencies - Relation to BRU
Eric Prescott - A4 architects- and Engineers	Project manager - Construction engineer	Has worked with renovation since 1994 and has thorough knowledge of the BRU-operation and has cooperated in many of these projects.
Ulla Beilin - SBS Rådgivning	Partner & Project Manager - Architect	Has worked with renovation for almost 30 years and has thorough knowledge of the BRU-operation and has been part of many projects. SBS used to be one of three state-owned renewal companies in CPH.
Mette Gammelby Kruse - Gaihede	Project Manager - Architect	Has thorough knowledge of the BRU-operation and has been part of many projects, especially cases about decreasing noise pollution within dwellings.
Nicolaj Niebling - Bangbeen (Architects and Engineers)	Project Manager - Construction engineer	Do not have as much experience as the above - but have been part of several BRU-cases.

5.1 Facilitating CE-measures within the legal frame of BRU

Since the Building Renewal Unit (BRU) is not developers, they cannot govern properties through any direct enforcement, only require that building-parts of a certain quality and materiality are applied in return for being co-funded cf. MBA 2.2. BRU for instance only allow A-class-windows and preferably build in solid wood with no plastic or metal frames, yet this can only be required if the preservation value of the property is high enough, which is mostly the case for properties build before 1930 (01:14 appx. 2). However, BRU strongly recommend sturdy materials in all cases, and goes further than minimum legal requirements of the Danish building act, and if an applicant do not wish to install such components, they are not likely to gain funding (44:00 appx. 1; 1:18:47 appx. 2).

Both external advisors and caseworkers use windows to exemplify this tendency and claim that people often want convenient, so called *"maintenance free"* windows, with outer frames made of aluminium. Thus, while these windows do not require significant maintenance through their lifespan such as paintjobs, they cannot be repaired if they attain larger damages, while solid wood windows can, and if they are maintained, has a potential lifespan of 100+ years (1:11:00 appx. 2; 47:50 appx. 4; 25:30 appx. 7).

Thus, when an agreement is consolidated with BRU, the property-owners and advisors are obligated to follow these requirements, and if they fail to do so, by e.g., installing different building-parts, they forfeit the claim of funding and BRU can refuse to disburse it. Notably, the grants are disbursed when BRU has received and approved the accounts of the construction-work after the renewal is finalised (KK 2021b). In short, BRU have eligibility criteria that must be met to be considered, and after that, caseworkers have autonomy to pick out 10-20 applications out of the 50-60, they receive, cf. 2.2 where they can influence the choices of solutions (appx 16). Followingly, this section goes further into the investigation of: **how the employees in BRU and external advisors perceive BRUs role in terms of facilitating measures to accelerate development of CE through building renovations?**

The external advisors claim that most private owners have the financial capacity to pay for renovation-works without BRU (33:20 appx. 6; 17:00 appx 7; 36:00 appx. 9). On the other hand, they believe BRU-projects can contribute to added qualities, e.g.: "*convincing the owners to renovate more thoroughly"*, to implement more expensive *"high quality components that can last longer"*, or adding extra components like "*green walls, functioning autonomously with a rain-water-system"*. (17:00 appx. 7; 9:00 appx. 8; 21:00 appx. 9). According to the advisors, the latter elements are believed to be something that private owners would not be likely to invest in, as they mostly focus on gains in a short-term perspective and keeping the price of the renovation down (23:00 appx. 6; 27:00:45:00 appx. 7; 18:30 appx. 8; 30:20 appx. 9). Further, one advisor expressed that funding from BRU could be even more focused on projects that entails measures above rectifying installation deficiencies. Even though some BRU-projects go further than this, it could be the case for all projects, as the advisor describe: *"Copenhageners are some of the most affluent on the Danish real estate market; why should they gain financial aid to do regular renovation?"* (33:20 appx. 6). Further emphasising how everywhere else in Denmark property-owners finance renewal by their own means. Thus, for BRU to keep being relevant, their projects need to be *"a catalyst for something more than providing financial aid to rectify properties"* (Ibid).

Another advisor, Ulla Beilin, agree that most property owners in MCPH, whether this is private or cooperatives, can muster the resources to pay for renewal (36:00 appx. 9). Yet, Beilin also nuanced the perspective in terms of whether BRU should aid standard renovation-works. Namely in the case of private rental, Beilin believes this may still be relevant, since rental-companies do not necessarily have the resources to rehouse occupants in case the rent increases due to renewal. Nevertheless, rehousing is your right as an occupant, if the rent increases above a certain point, and this dynamic can remove the incentive to keep the property up to the general standards of the area. As Beilin posits;

> "What I have experienced with building renewal in the past, is the fact that the "heaviest" properties with many installation deficiencies do a little [maintenance] along the way. But when you have given them the opportunity to rehouse residents and thoroughly renovate the building, then it has happened. The municipality has chosen to remove this option, as they believe the money can be used better; *"getting bricks, instead of rehousing residents"* [...] I think you could make some exception to this rule, for the worst properties" (35:50 appx. 8).

This points to the fact that, there may still be need for BRU's current role; rectifying properties due to deficiencies without requiring innovative measures, thus, only in the case of rental-companies, that does not have the means to rehouse occupants and keep their properties up to a decent standard. Thus, it also supports the claim that BRU-funds could be allocated for more specific interventions than what they are currently.

Hence, the premise, where applicants are primarily funded due to installation deficiencies, is allegiantly, not a legitimate reason in today's Copenhagen, because most owners are too affluent for this kind of aid (33:20 appx. 6; 17:00 appx 7; 33:00 appx. 9).

In this perspective, BRU should limit the building-renewal operation to focus on innovative measures and a separate operation that only comprises private rental-companies, that, within special circumstances can gain financial aid to rehouse tenants. This operation could e.g., be placed under the **condemnation team** that already handles properties of the poorest living conditions, cf. table 3. Thus, BRU should support renewal-projects upon terms, where innovative measures and deficiencies are equally important aspects.

This notion appears similar with the renovation strategy of common cooperatives, where the key premise of rectifying properties has been extended to focus on green measures, instead of a sole focus on dilapidation. In turn, part of the strategy for common cooperatives, is to make screening-processes to identify opportunities to implement elements that can showcase untapped potentials for making renewal and the following use-phase less resource and energy-demanding, cf. 1.4 (Transportministeriet 2020). The strategy of common cooperatives relates to **nurturing** since the screening processes can result in learning and new insights that can lead to sustainable solutions in renovations.

Regarding BRU, a similar strategy would entail more resource-demanding practises than the current process, where funding is provided according to eligibility criteria (cf. 2.3.1). Because the list of criteria makes the governance-role compliant with case-processing in a classical administrative way. However, it does not comply with a strategy where the key premise is to **nurture** novel practises, cf. 3.3. Accordingly, the following section will dive further into how employees of BRU perceive their role, and **how the organisational structure affects their possibility to facilitate measures to accelerate development of CE**.

5.2 The means need to fit the purpose

Head of the Building Renewal Unit, Janus Christoffersen, emphasises how the unit has started transforming from being a case-processing unit towards becoming a unit that also handles unique projects, which requires a significantly different approach, in terms of the organisational setup.

> [...] "our grants need to be synchronised with policy-goals and our organisation [and] we need to develop in minimum two aspects, one is about internal development within the unit. We are a newly formed unit, that have to find each other, find out how we can create collaborative relationships, **we have to develop competencies and change from being a case management unit to also being a project unit** [...] It is a complex task […] we sort of stand in the middle of everything [secondly] we have to understand the market, we have to understand the science, we need to get [external] advisors onboard with this, and involve them in the developments we want to achieve within the green transition. These tasks require a lot of communication and knowledge-gathering [otherwise] it would be pure case-processing and business as usual" (52:00; 1:10:20; 1:11:15 appx 3).

Accordingly, the employees of BRU emphasise how the unit needs to figure out how to prioritise the 100-150 million DDK that is being distributed annually and refers to a lack of a common foundation concerning what the unit wish to achieve by the renewal-funding (44:40 appx.1; 52:30 appx. 2; 54:00 appx. 3; 36:00 appx. 4; 01:16 appx. 5). As Erik Dam posits:

> "[...] we have not calibrated our understanding of what to prioritise regarding properties. Many talks about installation deficiencies - toilets, showers, district heating" [...] "there are also energy-optimising measures in which you can relate all kinds of things" [...] "a kind of Maslow's pyramid of building-measures" [others will claim] "the pyramid is turned upside down and the most important thing is circular economy" (44:40; 46:20 appx. 1)

Subsequently, employees in BRU knows there is room for changes, and possibly, re-prioritizations of resources and they believe that facilitating CE-measures should be a part of the practice. However, the four teams, cf. figure 6, have not ranked these priorities.
However, in a sense supporting circular practices is already part of their operation, e.g., by creating an opportunity for the property-owners to buy longer lasting building parts cf. 4.1 (19:00 appx. 2; 30:00 appx. 4; 46:20 appx. 5). Maybe, this is not within their self-perception, because they are not purposely facilitating measures to accelerate CE.

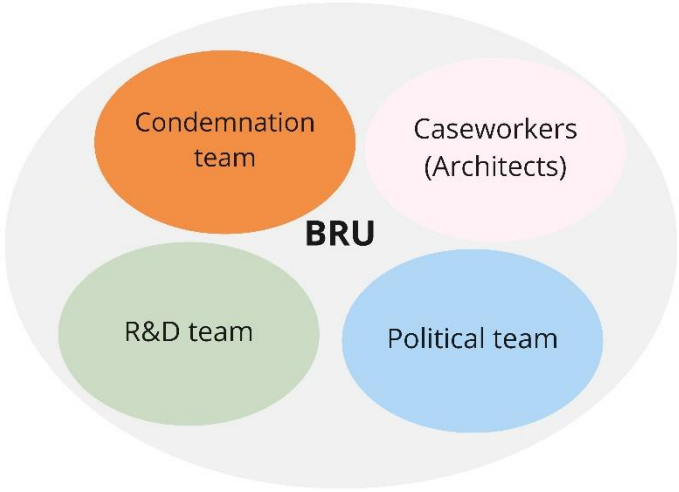


Figure 6. Organisational diagram.

Further, BRU could implement measures to facilitate circular outcomes without changing their practices significantly, e.g., by making requirements for recycling. One advisor pointed out that BRU could require that, e.g., window-glasses, be sent to recycling to make glass-wool (01:09:50 appx. 6). However, if BRU are interested in accelerating development, low hanging fruits is not adequate, as this does not accelerate developments that can stretch & transform the boundaries within the selection environment, it would merely be conforming to it cf. 3.2.

Thus, BRU have had a process- & screening tool to facilitate CE-measures since 2019, thus, it has just never been used to lead a project cf. 2.2 in this sense, the tool has not been an obvious success. According to employees of BRU, the two most obvious reasons are: 1) the process has not been politically consolidated 2) the four teams of BRU has not collectively agreed to rank CE as a one of the top-priorities in BRU (44:00 appx 1). What follows, is the fact that resources in BRU have been decreasing. Caseworkers have been halved in the past five years which has influenced the capacity to implement a radically different process.

Further, the R&D-team and the caseworkers are not very well aligned, since their cooperation has not been very significant, as Øystein Leonardsen expressed:

> "There has not been a close collaboration between the architect group and the R&D-group. Until now, it has been about attracting [external] funding for projects. And there are two things to that story, partly there has been a lot of preparation to get ideas, search for projects where they [Caseworkers] have been involved along the way, in the sense that we have asked them regularly, and to the extent they have had resources for it, they have also answered [...] This is the main organisational challenge we are facing right now." (01:16; 01:17:30 appx 5)

The process & screening-tool has been brought into BRU by the R&D-team as an externally funded development project. Thus, it has been developed by Lendager Group to suit BRUs case-management process. However, the caseworkers seem to have been very little, or not involved in developing the tool at all. One of the caseworkers expressed how the tool has to few categories and one of the three it does have, bricks, is not even very relevant for BRU, because very few bricks are removed during the renovations BRU are involved in, in turn wood is a more common material to be discarded during roof-top renovation (appx. 13 p. 115). Logically, Lendager Group must have developed the tool on the accounts of the R&D-team and some generic overview of the funding process, cf. 2.1, while the expertise from the caseworkers in BRU has not been utilised. Thus, this provides some explanation of, why the tool does not fit with the caseworkers' process. Following this, the next section will dive further into this process-tool, by first presenting a table that shows a graphical analysis of the process-tool, followed by an extended analysis that investigates the reasons why the tool is not useful.

Table 5. Graphical analysis of Lendagers Process-tool. The plotted areas are based on responses from all caseworkers in BRU, appx. 2; 4; 13.

CE-Measures BRU can facilitate/operationalise	Ambiguous	CE-Measures BRU Cannot facilitate/operationalise

Advisory meetings	**Preliminary application**	**Qualified application**	**Political Processing**	**Political commitment**	**Tendering**	**Execution**	**Post-project**
Phase 0	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**	**Phase 6**	**Phase 7**
Expectation reconciliation with advisors CE-Catalogue with inspiration. CE-section in the application form.	Ask specifically about CE-wishes in dialogue with applicants. CE-criteria in the final application. Prioritize advisors' experiences in driving a circular process.	Continues Expectation reconciliation with Advisors & prioritizing building-components with Residents. Examination & Assessment of materials & place-bound analysis by means of the screening-tool Prioritize applications that focus on circular solutions.	Factsheet with expected CE-effects (waste, CO2 & resource reductions) Presentation of the suggestions with politicians concerning the expected CE-effects. CE is incorporated as a political goal and criteria.	Dialog with technical experts concerning application and tendering. MCPH delivers tender appx. as inspiration for the applicants' allocation criterion & CE-criteria for the contractor to abide by.	Evaluate whether the tender align with criteria formulated in phase 4. Make sure to involve contractors early in the process. Make decisions on storage for the dismantled materials. Put CE-criteria in the contract.	Communication about CE-initiatives across the building site Develop a CE-action plan. Data-collection & registration of material uses etc. for further documentation & impact-analysis	Debriefing about the process with all concerned actors Development of a CO2-accounting-scheme & input for MCPH's climate accounts. Development of a new inspirational catalogue for the applicants. Results are evaluated based on tendering & CE-goals

The core problem with the process-tool is the fact that BRU is not able to accommodate adequate support to realise the measures it prescribes (20:00 appx. 2; 30:00 appx. 4). The caseworkers do not see how they can utilise the tool, because there are many elements, they do not have solutions for, while the measures they can operationalise are not adequate to run the process (29:30 appx. 2) cf. the green and orange-plotted areas on table 5.

According to the caseworkers the screening-tool can be applied to make an initial estimate of potential CO2 and waste-reductions of roof-tiles, glass, and bricks by visually assessing the building-parts on the property and retrieving knowledge of the year-group and quantity. Thereafter, the process is merely entering the data in the input-part of the tool and the estimate is provided cf. 1.3.1 While this can create focus about repurposing these components, according to the caseworkers, measures to do this, are not prioritised by the property-owners. An example could be "*planning to make a patio with old windows, the money is more likely used on unforeseen construction-work in the end"* (29:30 appx. 2).

In this notion, phases 1 & 2 are partly ambiguous since it would not be effective to "*prioritise advisors and applicants that focus on CE"* cf. phase 2, because it is not something property-owners care about cf. 5.1, as one of the advisors expressed it:

> "People know they can gain something, and in my experience, the economic interest is the driver. There are usually a few residents that are very focused on climate measures, e.g., solar cells or something like that, but in the end, economy is the key factor, *"and can we get something more for free"* (45:00 appx. 7)

Therefore, it seems more realistic that property-owners may be interested if it does not affect the price. Thus, according to the input-properties of the screening-tool the costs of dismantling is 60-80% more expensive than conventional demolition. Further, the caseworkers expressed that it is questionable how much of the components can be reused, because in the projects BRU are involved, the condition of materials are often worn to the point where a lot would not be possible to reuse. Thus, it would not be economically viable to dismantle and save those materials that may be suitable for reuse, which makes phases 3 & 4 ambiguous (Appx. 13 p. 101-103; 123).

Thus, the screening-tool is currently not an institutionalised part of case-processing, because the output is too uncertain and it has not, as the head of BRU expressed, been synchronised with the organisation, cf. city council, so using resources on expert's advisory prior to tendering seems unlikely, cf. phase 4 and is ambiguous. However, instead of using resources on advice, BRU could use recommendations made by the legal team of MCPH's financial administration. They recommend making reuse of materials an allocation criterion or requiring specifically what building-parts should be repurposed, how and where it should go for this to happen (Økonomiforvaltningen 2018).

Thus, the latter is something BRU do not find logistically operational and one of the caseworkers express that facilitating logistic solutions is the most significant barrier cf. phase 5, emphasising that the number of actors who receive old building materials to be reused are so few, that it would be market-distorting to recommend these, and how there are no possibilities of temporarily storing materials within MCPH. Even if this was the case, municipal storage facilities are not open to the public, cf. phase 5 (21:00; 29:30 appx. 2). Thus, in the caseworkers' view, the only possibility, is to require advisors to assess the possibilities of reusing the materials within the individual project, or alternatively passing the materials on to actors that can repurpose them (ibid.) Subsequently the caseworkers do not believe this approach leads to anything more than the business as usual. However, in relation to the lack of logistic possibilities for reusing existing materials, Dennis Nørup Knudsen, expressed that the caseworkers have started to discuss the potentials of incorporating **design for disassembly** as a CE-measure that could be tried out in demo-projects. However, also emphasising that it has only been loose discussions and ideation within the group of caseworkers, thus, not something that is just about to become a premise for demo-projects (44:00 appx. 2).

In turn, designing for disassembly would be a sensible focus for BRUs projects, and according to the urban renewal act chap. 4 §25, BRU can decide to have specific criteria for how the renovations are carried out, cf. 2.2.

Incorporating design for disassembly as a premise could be a way to nurture this niche-practice and dismantlable designs can in practice be implemented on a system- or component-level in a renovation (Circle House lab 2020 p. 14). Thus, BRU often grant renovation of climate screens, e.g., roof-tops and windows, which relate to one construction-system and one component in which may be possible to replace with dismantlable

versions, and as Dennis Nørup Knudsen, noted: "*if we make 10-15 of these projects, the advisors and contractors will gain experiences they can use going forward"* (45:40 appx 2).

Further, it is ambiguous whether phase 6 & 7 can be facilitated, because the outputs of the screenings are quite rough, and may not be valid enough to enter in MCPHs official climate accounts. Thus, BRU could use the data for internal evaluation and learning. However, this is also ambiguous because the renewal projects are usually not evaluated (24:00 appx 12). One of the advisors even expressed that an inquiry for data and general insights from one of BRUs demo-projects could not be provided, because nothing had been retrieved. In turn, it was also noted that lack of evaluations was probably not the fault of BRU, but rather a matter of resources in MCPH (14:45 appx 6). This latter claim holds some merit, as evaluations are not part of the caseworker's process, thus not something they are paid to do (24:00 appx 12). The advisor further expressed that data on technical performances from demo-projects is extremely important, because without these, there will never emerge points of reference that lead others to implement the solutions. In turn, evaluations would require that BRU made accounts of the economic aspects as well as CO2- and waste-reductions and perhaps also that project was revisited e.g., five-ten years after finalisation to check up on performance and gain useful insights for internal learning and for others to use.

Sub-conclusion

BRU believes that facilitating measures to bring about circular outcomes is within their role, yet the most significant reason to provide renewal-funds, is to help property-owners rectify properties with significant installation deficiencies. However, the external advisors argue that BRU's contribution may not be very significant in this regard, since they believe most private owners have the means to invest in renovation without funding. Thus, even though the funding from BRU may increase the material quality of a renovation and add qualities like e.g., a green, the focus could be directed more on innovative construction-solutions to showcase projects that can be beneficial, not only for the property-owners, but as examples for actors in the building-sector to be inspired by. Hence, BRU should stop providing financial aid for standard renovations, and instead focus on being a catalyst for innovative measures. In turn, properties could be assessed more thoroughly in terms of which kinds of sustainable measures that could be relevant for the individual property, instead of providing funding based on generic requirements. Moreover, measures relating to **closing the loop** is largely passed on to the advisors, because BRU cannot support reuse of building parts due to lack of internal logistic possibilities in MCPH, and too few or no market actors handle reuse of materials. Further, it seems that reuse of materials is not the most relevant measure to be concerned with, because the caseworkers rather advocate maintaining existing building-parts when this is possible, and when this is not the case, the components are too badly worn, in which case reuse is not ideal. In turn, the concept design for disassembly was highlighted as a viable measure BRU could instigate projects upon, e.g., in relation to roof-top-replacements.

5.3 Facilitation through enablement

The last section concluded that the process-tool that should have enhanced BRUs capacity to facilitate measures leading to circular outcomes has been parked in a corner, because: 1) the tool has been brought in on the R&D-teams' initiative, disconnected from the rest of BRU 2) the process has not been politically consolidated 3) the four teams of BRU has not collectively agreed to rank CE as a one of the top-priorities in BRU, this has not been discussed yet cf. 5.2; 44:00 appx 4. Following this, the next section goes further into the processes leading up to promise of funding, and after that, dives into the perspective of facilitating through enablement, and answers; **how BRU can improve their capacity to facilitate circular measures in the renovation-projects?**

5.3.1 The process of a BRU renovation-project from application to promise of funding

A renewal-process with BRU is normally a three-year process, cf. 2.3.1 and this section provides an explanation of the initial processes that occurs during the first year, up to the point where BRU has made promise of funding, upon an agreement which advisors sent in tendering. Thus, before BRU receive a preliminary application, there has already occurred a process between property-owners and an advisor. Most commonly, these advisors know BRU and recommend property-owners to apply for a grant, if they believe the condition of the property correspond well with BRUs eligibility criteria (44:00 appx. 4). Before BRU receive the preliminary application, advisors and property-owners has an opportunity to discuss the application with BRU in **January-February** to address any doubts. Next, caseworkers assess the applications according to their criteria and sent out answers to the applicants in **April**. In the next step, caseworkers and advisors inspect properties to clarify which parts of the project BRU may be able to co-fund and further discuss which technical solutions could be suitable. Then, advisors consolidate with their client and upon agreement finish and submit a qualified application, due late **August**. Next, caseworkers modify the qualified applications in **September** and **October** and submit these for political approval at city council.

Subsequently, the process leading up to a promise of funding takes a year, and in the last part of this process, BRU can modify the qualified application, even though, there has already been an iterative process focused on qualifying it. Thus, one advisor expressed how; *"the qualified application should either be approved or rejected. It is a shame when it is approved on conditions where the budget is no longer valid"* [...] *"it is associated with a huge loss of credibility for the administration-boards or for us to go back and say, we know you approved 12 million, but we need 13,5"* (9.40; 12:30 appx. 6).

On this note, the following analysis dives into the aspect of facilitating through enabling and highlights perspectives where BRU needs to make extra efforts to accelerate development of circular practices in the renovations. Furthermore, there will be presented process-criteria and concrete circular initiatives BRU can instigate in collaboration with property-owners and their advisors.

5.3.2 Communication

Caseworker, Søren Bjarnø, point out that the communicational efforts are lacking behind in BRU, something he has noticed, while discussing renewal projects with applicants and their advisors, as he expressed: [...] *"sometimes you get the feeling that they are not aware of the things we aim to do"* [...] *"it is a major focus, that solutions should give something back to the city"* (36:00 appx. 4). In turn, Bjarnø expressed that applicants need to be provided with arguments and the "*good story",* behind the criteria, since it cannot be expected that they understand why BRU require specific measures in return for the funding, rather he believes "*it can be misunderstood as a matter of good or bad taste*" when e.g., solid wood windows are required instead of alu-framed ones (49:00 appx. 4). Bjarnø further expressed that communication and the proactive part of getting applicants interested in BRU could be extended; *"right now it is mostly on the advisors, while we* [caseworkers] *have very little to do with it, which is something to consider"* (55:00 appx. 4).

Thus, the interaction between BRU, applicants and their advisors, mostly happens through written material, e.g., application forms, guidelines with extended explanations of requirements and catalogues of possible solutions (54:12 appx. 4). Upon this, it is up to the advisors and property-owners to determine if it seems relevant to aim for the funding.

Thus, according to the advisors, the application-process is very demanding, and as a result, there is a degree of aversion towards entering projects with BRU (3:40 appx. 6; 2:20 appx. 9; 14:00 appx. 8). In this perspective, communication-effort seems inadequate to solve the pressing issue of disconnect between BRU, applicants and advisors. One advisor expressed that BRU "*can be hard to sell"*, and some developers believe they can do it "*cheaper and faster without BRU"* (6:30; 36:00 appx. 9). The advisors further expressed how they and property-owners believe that BRU on some occasions has radically changed the terms of settled agreements, which they connect with two aspects: **political turmoil** on a political level in MCPH and **incomprehensible approvals of applications** by caseworkers, cf. 5.3.1. One advisor expressed that; [...] *"there is not* [always] *political certainty about what one can do with the funds, therefore it can appear very untrustworthy when recommending BRU"* (13:00 appx. 9), and provides an example from a recent project:

> "I had a property that was organised with BRU, but now it runs without them. It is very dilapidated with single-glazed windows, no bathrooms or central heating. It was a high priority case for BRU, and the agreement was that central heating should be installed and the climate screen be renewed, **but no bathrooms**. This was approved at first [but] along the way the decision was re-evaluated politically, they [MCPH] had become nervous about supporting the property within the given terms [their message was] *'now we only support properties if bathrooms are installed'* - "before that, it was voluntary" (13:00 appx. 9)

6). This corresponds to governing by **control and command**, cf. 3.2, where BRU expects advisors and applicants to abide by their rules and follow prescriptions along the process, without having influence on significant decisions, cf. 5.3.1.

Hence, the uncertainty around the process creates a situation in which property-owners and advisors may experience loss of control. Subsequently, this leads to an aversion towards BRU, because they do not understand the reasons behind the criteria, combined with uneasiness related to the bureaucratic system that can overtop agreements and derail a project. Consequently, these disconnected processes do not create ideal conditions for developing projects that challenge business as usual and empower niche-practices. On the contrary, it fits to the perspective of **mistrust** among actors, where resources are spent on risk mitigation, instead of creating a space for collaborative ideation cf. 1.3.

5.3.3 Fixed criteria

Further, an advisor expressed how the premise of initiating projects with measures above business as usual should be more open-ended in the BRU-projects:

> "[BRU could ask] what are the sustainable elements in this [project] - what do you intend to do which is something special, that makes you take a risk, that makes you need financing to try something extraordinary […] Right now, it is a requirement to reduce energy-use by 20%; it is insanely difficult to achieve and a huge obstacle. In many cases we [just recommend installing] solar cells until we reach 20% [...] Though, I am not convinced that solar cells from China is the most sustainable solution" (35:40 appx. 6).

This comment supports the argument that advisors are just abiding by the criteria even though they do not necessarily agree that it leads to optimal solutions. Subsequently, BRU should leave the practice of command and control by fixed criteria and instead be more proactive and facilitate a case-based process related to the individual properties.

Furthermore, two advisors claimed how increasing funding from the usual, 25-33% to 50% cf. 2.1, may not be the most effective incentive to make property-owners enter a demonstration project with experimental solutions (24:10 appx. 6; 29:20 appx. 9). Because if there are no instructions in the building act on the present solution, liability pass to the developer, who ceases the legal right to require any compensation from advisors and contractors if the solution does not live up to expectations (24:10 appx. 6). Hence, advisors do not believe increasing funding for demo-projects changes this and a project will likely remain within the legal capacity of the building act. This may be hampering the possibilities to **stretch & transform** elements within the current selection environment and **empower** radical changes in renovation-practices. In this regard the advisors suggests that BRU or MCPH should claim legal liability of untested solutions and make guarantees of compensation. (24:10 appx. 6; 29:20 appx. 9).

The findings of the analysis cf., 5.1, 5.2 & 5.3 has led to the following list of recommendations for new processes criteria in BRU:

- Make the premise of providing funding case-based and assess applications on the premise of flexible criteria instead of fixed criteria and stop providing funding for property-owners that merely want to instigate regular maintenance.
- Provide incentive by claiming the legal liability of components or constructional solutions that are untested, e.g., experimental biobased insulation-materials like seagrass.
- Reduce the amount of funding and reallocate these to disburse compensations for unforeseen problems during construction and a period after. This could for instance work like an insurance, in which the compensation decreases according to the age of the components or construction-systems.
- Individualise criteria of success on the renovation-projects and involve the advisors and other relevant actors in this process.
- The R&D-team shall be involved in the renovation-projects to build up capacity and increase resources to identify possible solutions in individual cases.
- Evaluate the projects and collect the insights in a catalogue to keep improving information about solutions.

It should be noted that the recommended criteria should not replace the old ones completely in the sense that a property should still be in need for renovation to be considered.

The list of processes is however, only one side of the coin and BRU also need to clarify concrete CE-measures to make it clear what kind of measures they want to support. The employees suggested projects revolving around design for disassembly, because this can optimise parts of the building and provide better opportunities for utilising materials in a circular way, regarding easier maintenance and the opportunity to reuse components for new purposes in the future. The followingly list of recommendations further suggests that BRU should support better utilisation of space in properties. These suggestions are based on MCPH's goal of providing better opportunities of decreasing consumption, by making it easier for Copenhageners to share more cf., 2.2. Further, the recommendations rely on the facts that, Danish citizens use of floor-space is

disproportionate with responsible consumption of resources, there are many singles in Copenhagen, and potentials for utilising roof-top-storeys to install dwellings cf., 1.4. This leads to the following examples of initiatives beyond regular maintenance in relation to CE:

- Instigating demo-projects focused on design for disassembly and provide advisors and applicants with informative material and thorough explanations on possibilities for implementing construction-systems or components that can be disassembled and dislocated from a building unscathed.
- Make it possible to apply funding to optimise space in a dwelling, e.g., changing the layout to something that suits shared living. Notably, it would be sensible to make it a requirement, that x number of people are moving in, to get funding for space-optimising an apartment. A measure for this could be based on the size of the apartment and number of rooms after renovation.
- Make it possible to apply funding to optimise unused living-space e.g., in roof-top-storeys, e.g., to make it possible to install small apartments for singles or expand existing dwellings to house more tenants.
- Make it possible to apply funding for making shared spaces in a property, e.g., hobby-rooms or repair-rooms.

Thus, property-owners and advisors should be encouraged to make motivated applications and argue how their project comprise something **beyond regular maintenance**, which e.g., could be measures that relate to space-optimisation and design for disassembly. In turn, BRU needs to **clarify what kind of measures are beyond regular maintenance** and provide thorough explanation of this by exemplifications to create ideal preconditions upon which property-owners and advisors can make valid applications.

Instigating projects upon design for disassembly and space optimisation

One way to go about renovations focused on implementing dismantlable construction-systems and components, could be to make a concrete premise around the application-process by making an update on BRUs website to inform about the new criteria to anyone interested in applying for a grant, and inform well-known advisors about it directly. The latter may increase the chance of making advisors look for potentials relating to

these measures in their initial interaction with their clients. Hence, this would be a valuable thing, in terms of initiating early engagement between BRU, advisors and the owners. Further, when advisors explain BRUs agendas to the owners, they gain an understanding from the beginning, which makes the premise of ideation focused on concrete aspects. For instance, how to install windows and a roof that can easily be dismantled or how to go about a project focused on space optimisations.

Thus, instigating projects with a focus on space-optimisation could both be focused on the individual apartments in which funding could be applied to change the layout of apartments to suit shared living. Further, changes for a whole property, could e.g., entail shared spaces such as hobby- or repair-rooms with proper equipment and tools. Moreover, there are properties in Copenhagen's buildings-stock with top-storeys that could be utilised for apartments or common-rooms cf. 1.2.1. Further, to make shared solutions more flexible in terms of multifunctionality, partition-walls should be dismantlable or even movable, to accommodate flexible usability of the space presently and in the future.

6. Discussion

This chapter present a discussion revolving around possibilities and challenges based on the findings of this report, especially the recommendations for processes and concrete circular criteria.

6.1 Opportunities and challenges regarding resources and expertise in BRU

The analysis has shown that the employees of BRU has a will to instigate projects with circular initiatives and that there is a large degree of expertise to support this within the unit. The employees generally have a clear notion of CE and initiatives that relate to this, especially the caseworkers' thorough knowledge about material-properties and construction-methods qualifies them to support recommendation of circular solutions, and they already do this to some extent by e.g., advocating for windows with long lifespans, and generally, to maintain instead of replacing, when this is possible. Furthermore, the recommendation made in this report, may not necessarily increase the workload on the caseworkers, if it becomes obligatory to make a motivated application, it is likely that the number of applications will decrease, and if not, it will be easy to sort out the ones without valid arguments. Thus, renovation-projects instigated on the premise of the criteria recommended in this report, would arguably be possible for the caseworkers to operationalise. Further, the R&D-team could also function as caseworkers within this setup, while they do not possess thorough expertise on constructions, they can still discern whether a project is worth looking in to.

Further the R&D-team could assist by being part of the dialogue with property-owners to understand their needs and visions for renewals on the property and use this information to search for suitable solutions. In practice, this could for instance entail reaching out to manufacturers of niche-products that may be fitting for a property, and to make sure the agreements to use the present solution become consolidated between all parties.

However, the R&D-team spent many resources on retrieving funding to run development-projects, and therefore it is questionable that they can spent a lot of time being engaged in the renovation-projects. Arguably, this creates a dilemma where the R&D-team may not actually be able to support a more case-based process, unless it corresponds to activities of a development-project. Thus, the analysis of the process & screening-tool showed an example of a development-projects that was very detached from the rest of the unit, and ended up, not bringing much value. On the

contrary, another part of this explanation could be, that the rest of BRU does not have time to be engaged in development-projects and the failure to utilise these tools may as well be explained by a lack of efforts to implement it. The caseworkers run the application-processes every year, starting in January and when they have executed one application-process, the next begins right after. Thus, it is probable, that even if the case-workers are interested in changing the current case-process it is difficult to realise in practice. Thus, a third explanation could be the lack of consensus and utilisation of the expertise within the unit. Trial and error can only be expected when developing something new, therefore it is important that it is agreed upon to secure engagement around the development and continuous participation during the processes to gain feedback and reconcile around these efforts. Thus, before using a lot of time and resources on development-projects BRU needs to be reconciled about the purpose and goals they expect to achieve, and the R&D-team should base their projects on these visions and use the expertise of the other teams to qualify which kind of projects to develop.

6.2 Political support

All the interviewed employees believe that BRU should support circular transition. Even still, it may be unrealistic to change BRUs process and criteria as radically as recommended, because there is nothing from a political level requiring them to do this. Thus, if the technical and environmental committee and the city council believe BRU are providing a necessary service in Copenhagen, why should the employees in the unit start contesting this? Moreover, BRUs current criteria is well aligned with legislation and the climate-plan, cf., 2.2. The legal framework prescribes that a grant can be disbursed when a property is built before 1960 and deficiencies that are foremost considered is **no connection to district heating, no toilet & shower in the apartments and noise pollution**. Furthermore, MCPH's has set out a goal in the climate plan that properties going through co-funded renewal should **decrease energy-consumption by 20-30%**. In turn there is no reference-point which directly legitimise BRU to facilitate the measures recommended in this report, there is only open-ended goals, e.g., that MCPH **perceive buildings as material-banks** and **focus on providing citizens with better opportunities to share more,** cf. 2.2. Thus, even though space-optimisation and design for disassembly relate to these goals, it needs to be acknowledged and approved as a legitimate administrative foundation for BRU. This may be a challenge

because BRU are foremost supposed to provide the service that correspond to the legal foundation, c.f. 2.1, which foremost prescribe rectifying deficiencies not changing layouts.

Further, the current operation is a way for MCPH to support energy-optimisation of very energy-consuming properties. Thus, even if it is true that most property-owners can pay for this themselves cf. 5.2, for one, they may wait longer to do it, and supporting energy-optimisation of 1000 dwellings (10-20 properties) every year cf. 2.2, is a concrete and measurable way for MCPH to support environmentally sustainable developments of Copenhagen's Building-stock. Whereas it may not be as easy to measure the benefits of space-optimisation focused on e.g., installing multi-functional common-rooms, this would require qualitative follow-up assessments to evaluate the benefits of these instalments. For instance, assessing how often the rooms are used and how many items people share among each other, activities performed etc. On the contrary, space-optimisation of individual dwellings or instalment of more dwellings in properties, can be assessed quantifiably, by noting the increase of residents and e.g., an estimate of how much material and CO2 the construction has led to compared to installing the same amount of floor-space to house x number of residents in a new building. Thus, in an overall perspective these measures require more resources allocated for evaluation-processes, which is not currently a priority in BRU cf. 5.2.1. However, evaluations are a precondition, if BRU are to act as change agents that can adapt their activities, and empower niche-practices, by using feedback to qualify the premise of providing funding. Furthermore, this makes it possible to continuously update catalogues with inspiring cases, that can both be valuable for potential applicants, and for professional actors in the building-sector that are interested in the solutions.

7. Conclusion

This report has investigated how the Building Renewal Unit (BRU), in which co-fund renovations of private properties, can accelerate development of circular renovation-practices. The aim has foremost been to understand how this municipal unit in MCPH can increase their capacity to instigate renovations with circular activities being a key premise. This has been done by interviewing employees from the four teams in BRU cf., 4 and representatives from four of the adviser-firms in which BRU has collaborated with on several renovations. As a supplement, the analysis also draws on four interviews with BRU caseworkers, which had a specific focus on a process & screening-tool aimed to enhance circular activities in the renovations. The analysis is based on the theoretical perspectives, the transition-theory Multi-Level Perspective (MLP), combined with governance-concepts and Strategic Niche Management (SNM). The combination of governance-concepts and transition-theory has conceptualised the understanding around, how a group of actors can empower niches and support the diffusion of circular activities. Within this framework, this report has explored how **the Building Renewal Unit can facilitate measures to accelerate development of the circular economy in renovations?** This has been investigated through four research questions that collectively answer this problem formulation.

Research question 1 investigated **how the employees in BRU and external advisors perceive BRUs role in terms of facilitating measures to accelerate development of the circular economy through building renovations?**

It was found that both external advisors and BRU believe that circular measures should be integrated in the renovation projects, however, BRU has no strategy or procedures to run projects where CE is a key priority. However, it was also found that renovations often gain higher quality components when BRU is involved, because this is required to gain funding. Thus, even though property-owners may be convinced to go for repairable quality-components, the external advisors claim that most property-owners can finance renovations without co-financing. Thus, BRU should increase the ambitions for the projects and implement measures to showcase renovations that entail something out of the ordinary.

Research question 2 investigated **how BRU can facilitate measures to accelerate CE within the organizational framework of the unit?**
It was found that the employees of BRU have not collectively reconciled which perspectives are most important to support through the grants. This leads to unstructured processes, where the four teams of BRU are disconnected from each other and instead of building up capacity in collaboration, the team's function separately within their own functions, which does not provide a foundation to facilitate unique projects, rather it leads to business as usual, cf., 5.2. In turn, it was found that a process- & screening-tool was brought into BRU in 2019 to enhance BRU's capacity to facilitate circular outcomes, yet it has never been used to lead a renovation-project. The tool was not deemed a valid alternative to replace the existing case-process, because the activities prescribed by the tool could not be supported by the caseworkers, cf., 5.2.1. In turn, the caseworkers already advocate that building-parts are restored when appropriate, and alternatively reused or recycled when this is possible. However, the logistic opportunities for reuse are often not adequate which is often a barrier. Subsequently, it was found that BRU could easier lead projects based on design for disassembly, in the acknowledgement that possibilities for reusing the existing is problematic. Hence, ensuring easier maintenance and reuse in the future, by installing dismantlable systems and components, would currently be a more feasible way to secure circular outcomes in the renovations, cf. 5.2.1.

Research question 3 investigated: **How BRU can improve their capacity to facilitate measures to accelerate development of circular practises in renovations?**
It is found that BRU currently lead the projects **by command and control**, cf. 3.1, which has created a disconnect between caseworkers and external advisors. In some cases, this has led to projects characterised by mistrust and risk mitigation, rather than fostering solutions by collaborative efforts. Further it was found that, BRU should stop having fixed criteria and instead lead the projects more case-based upon flexible criteria. In this perspective the premise of receiving a grant should be considered upon motivated applications, in which the property-owners present valid arguments to explain why BRU should co-fund the project. In this regard, the following process and project criteria is presented as recommendations that can increase circular outcomes in the renovations BRU co-fund:

Process-criteria

- Make the premise of providing funding case-based and assess applications on the premise of flexible criteria instead of fixed criteria and stop providing funding for property-owners that merely want to instigate regular maintenance.
- Provide incentive by claiming the legal liability of components or constructional solutions that are untested in the market, e.g., experimental insulation-materials like seagrass.
- Reduce the amount of funding and reallocate these to disburse compensations for unforeseen problems during construction and a period after. This could for instance work like an insurance, in which the compensation decreases according to the age of the components or construction-systems.
- Individualise criteria of success on the renovation-projects and involve the advisors and other relevant actors in this process.
- The R&D-team shall be involved in the renovation-projects to build up capacity and increase resources to identify possible solutions in individual cases.
- Evaluate and catalogue projects to keep improving information about solutions.

Project-initiatives

- Instigating demo-projects focused on design for disassembly and provide advisors and applicants with informative material and thorough explanations on possibilities for implementing construction-systems or components that can be disassembled and dislocated from a building unscathed.
- Make it possible to apply funding to optimise space in a dwelling, e.g., changing the layout to something that suits shared living. Notably, it would be sensible to make it a requirement, that x number of people are moving in, to get funding for space-optimising an apartment. A measure for this could be based on the size of the apartment and number of rooms after renovation.
- Make it possible to apply funding to optimise unused living-space e.g., in roof-top-storeys, e.g., to make it possible to install small apartments for singles or expand existing dwellings to house more tenants.
- Make it possible to apply funding for making shared spaces in a property, e.g., hobby-rooms or repair-rooms.

Research question 4 presented a discussion concerning **opportunities and challenges for BRU to implement the processes and criteria recommended in this report.**

Regarding opportunities it is suggested that BRU has expertise that makes the unit able to lead projects to circular outcomes, especially regarding the thorough knowledge of construction-systems and material properties of components. Further, making the premise of funding based on motivated applications may make it easier to choose valid candidates early in the process, upon which BRU can start identifying solutions in collaboration with property-owners, external advisors, and the R&D-team in BRU.

Regarding challenges, it is suggested that it will be difficult to change BRUs operation, because it is tied to the legislation of the urban renewal act, cf. 2.3.1. Further, it is suggested that the process of changing processes may be difficult because it requires a lot of time and resources for BRU to draw up the argumentation, and afterwards get it politically approved as a valid administrative foundation. Further, if the political level of MCPH believe BRU currently provide a valuable service for Copenhagen citizens, there are no reason or basis to change the operation. Hence, it supports the political goal in MCPHs climate plan, of reducing energy-use of existing properties by 20-30% and it is questionable whether the city council will believe it to be necessary to extent the focus of energy-optimisation with the recommendation of this report.

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List of appendixes: Separately uploaded on digital exam:

Appendix 1: Interview with BRU employee, Erik Dam

Appendix 2: Interview with BRU employee, Dennis Nørup Knudsen

Appendix 3: Interview with BRU employee, Janus Christofferson

Appendix 4: Interview with BRU employee, Søren Bjarnø

Appendix 5: Interview with BRU employee, Øystein Leonardsen

Appendix 6: Interview with external advisor, Eric Prescott

Appendix 7: Interview with external advisor, Mette Gammelby Kruse

Appendix 8: Interview with external advisor, Nicolai Niebling

Appendix 9: Interview with external advisor, Ulla Beilin.

Appendix 10: Transcription of a panel-debate on Building Green Conference [04.11.21]

Appendix 11: Internal BRU guideline describing how the new environmental criterion (MBA) affect the renewal grants.

Appendix 12: Interview with former BRU employee, Marie Baumann and current BRU employee Karin Bahkti.

Appendix 13: Interviews focused on the process & screening-tool, with the four caseworkers in BRU.

Appendix 14: Screening-tool by Lendager

Appendix 15: Process-tool by Lendager

Appendix 16: Field notes

Appendix 17: Data on applications

Appendix 18: Interview-guides.