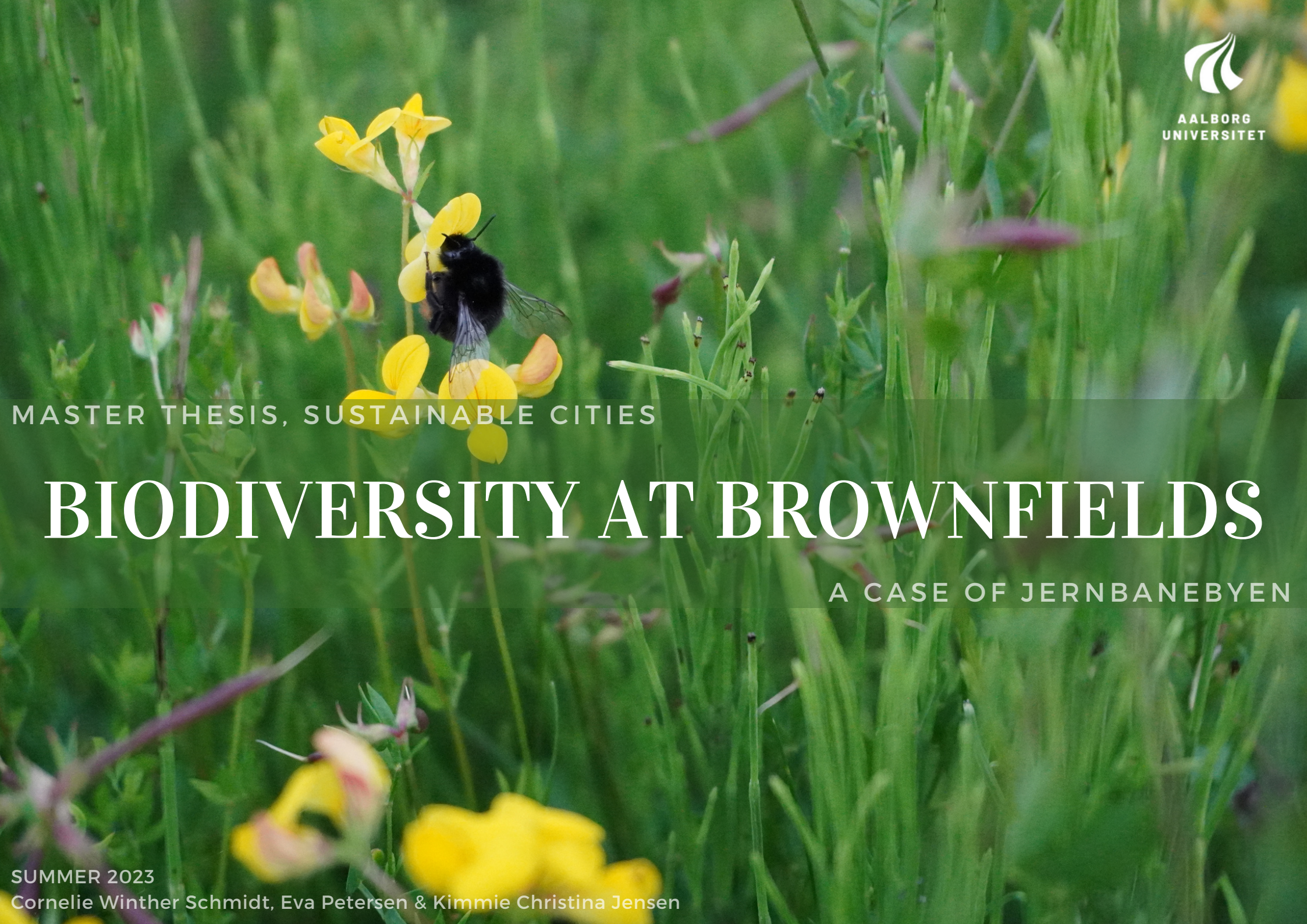

AALBORG UNIVERSITET

MASTER THESIS, SUSTAINABLE CITIES

BIODIVERSITY AT BROWNFIELDS

A CASE OF JERNBANEBYEN

SUMMER 2023

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ABSTRACT

With this thesis we have investigated planning of biodiversity at brownfields and explored the urban development project of Jernbanebyen in Copenhagen. The biodiversity crisis is at least as severer as the climate crisis with cities' expansion and resource consumption as some of the main reasons. Habitat destruction are the biggest threat to biodiversity and thus, there is a need to ensure ecosystems both inside and outside city borders.

The stakeholders' vision for Jernbanebyen has placed great emphasis on biodiversity, and the site's natural and cultural history are considered in their endeavor to develop a multifunctional and sustainable part of the city.

Our thesis has with a pragmatic approach and the multi-level perspective examined how to support the stakeholders' ambitions for biodiversity at the site. Through this approach, the thesis discusses how biodiversity can be integrated in future developments of brownfields based on the findings of this research as well as summaries concrete recommendations for the developers on the site.

If the developers adopt our recommendations, strive to change the regime, and continue to be committed to biodiversity while developing the site, our research suggests that Jernbanebyen can demonstrate how to plan for biodiversity at brownfields in the future.

SAMMENFATNING

På globalt plan er én ud af verdens otte millioner dyre- og plantearter truet af udryddelse (United Nations Environment Programme, n.d.-a), og handling er derfor nødvendigt for at undgå acceleration af arternes nedgang, som i dag sker 100-1000 gange hurtigere end noget andet tidspunkt i menneskehedens historie (Miljøstyrelsen, n.d.-a). Initiativer som FN's 17 Verdensmål sætter fokus på at beskytte, genoprette og fremme bæredygtigt brug af økosystemer (United Nations, n.d.-a), men verden står stadigvæk over for en meget stor opgave for at modvirke tabet af biodiversitet og ændre status quo. Dette blev understreget ved den globale biodiversitets konference (COP 15) i 2022 (United Nations Environment Programme, n.d.-b).

Biodiversitet er truet af, at menneskeheden hvert år bruger flere ressourcer end Jorden regenererer, da verdens økosystemer ikke genoprettes i samme hastighed som de udnyttes (United Nations Environment Programme, n.d.-a). Derudover er den nutidige største trussel mod naturlige levesteder dog ændring i arealanvendelse, der påvirker arter på land, i ferskvand og i havet (WWF, 2022a).

Danmark er på globalt plan den næstmest dyrkede nation i verden målt på arealanvendelse og har en dårlig bevaringsstatus af arter og naturtyper, der er beskyttet af Habitatdirektivet(Ejrnæs et al., 2021). Den begrænsede plads til naturen er problematisk, da det er

nødvendigt at give plads tilbage til naturen for at modvirke tabet af biodiversitet (Greenpeace, n.d.).

Historisk set har natur og by været anset som hinandens modsætninger (Rambøll, n.d.) og på trods af, at vi i årtier har haft fokus på bæredygtig byudvikling, er det nødvendigt med et nyt paradigme til fordel for biodiversitet. Dette er afgørende for understøttelsen af habitater og for arters overlevelse, da små og spredte naturområder udfordrer mange dyre- og plantearters udvikling samt formering på tværs af levesteder (Miljøstyrelsen, n.d.-c). Det er derfor nødvendigt at implementere biodiversitet i byudvikling i højere grad end i form af rekreative parker og 'grønne pletter' i byen, og det kan indtænkes som en del af klimatilpasningsløsninger og understøtte byernes bæredygtige udvikling.

Dette kandidatspeciale sigter mod at besvare i hvilket omfang at biodiversitet er integreret i byudviklingsprojektet *Jernbanebyen*, i København, og hvordan biodiversitet yderligere kan integreres i fremtidig byplanlægning af forurenede grunde.
Bæredygtighed og grønne elementer sidestilles i Jernbanebyen's vision og dermed defineres elementerne af den bæredygtige bydel ud fra interessenternes forståelse af områdets naturhistorie. Udviklerne anser områdets flora og fauna som et bevaringsværdigt element i lige så høj grad som de bevaringsværdige kulturbygninger i området.

Vores forskningsstrategi er understøttet af en pragmatisk tilgang kombineret med anvendt forskning og *multi-level perspective* som teoretisk ramme for at undersøge Jernbanebyen og udforske det eksisterende planlægningsparadigme, som Jernbanebyen og dens

interessenter er en del af. Vores agenda er situationsbestemt og handlingsbaseret, da vi ved at bruge semistrukturerede interviews og løbende dialog med Jernbanebyen's interessenter tilstræber at opnå en dybere forståelse af de aktuelle problemstillinger inde for byudvikling i henhold til biodiversitet og vores interessenters positioner, perspektiver og muligheder. På baggrund af dette indeholder rapporten vores anbefalinger til udviklerne i Jernbanebyen med henblik på at påvirke dem til at understøtte biodiversitet i endnu højere grad.

Gennem vores todelte analyse har vi undersøgt Jernbanebyen's interessenters perspektiver på biodiversitet i byplanlægning til at forstå kompleksiteten af udviklingen af området angående biodiversitet og hvordan, at interessenterne kan understøtte det. Dette gælder både under planlægning, udførelse og efterfølgende drift af området. Analyserne har muliggjort en vurdering af forskellige nicheinnovationers potentiale for implementering i Jernbanebyen. Nicheinnovationerne udgør tiltag, der skal hjælpe og understøtte udviklernes arbejde med biodiversitet på site og er allerede anvendt i byudviklingsprojekter.

Udover det bidrag Jernbanebyen's udviklere kan yde til biodiversitet ser vi, at det er nødvendigt med et paradigme skifte af det eksisterende byplanlægningsregime for, at de analyserede nicher kan etableres i flere udviklingsprojekter. Vores diskussion har derfor fokuseret på det eksisterende regime og nødvendigheden af at ændre dette for, at de analyserede nicher kan finde stabilitet i regimet.
Diskussionen understreger blandt andet hvordan, at EU Taksonomien kommer til at kræve at der tages yderligere stilling til biodiversitet ud fra et holistisk perspektiv. Derfor mener vi, at udviklerne skal være modige og gennem sociotekniske eksperimenter tage ansvar for at sikre erfaringer til gavn for fremtidig udvikling af forurenede grunde i byen. Dog er et paradigmeskifte til fordel for biodiversitet afhængig af de største magter i regimet, der skal sikre, at lokale projekter kan udvikles holistisk, hvor biodiversitet inddrages fra begyndelsen på niveau med andre bæredygtige tiltag.

Vores anbefalinger til udviklerne tager udgangspunkt i nicheinnovationerne og vores forståelse af de diskuterede strukturer i regimet. Anbefalingerne inkluderer etablering af en markedsdialog, der sikrer, at biodiversitet er en central del af udbudsmateriale og tiltag for bekæmpelse af lysforurening med hensyn til følsomme arter samt menneskets sikkerhed. På sigt skal interessenterne yderligere inddrage borgerne i stedets biodiversitet via engagerede aktiviteter såsom en udpeget 'naturrute', der strækker sig gennem Jernbanebyen. Dette anbefales for at borgerne opnår en forståelse af biodiversitet og en stærkere relation til stedets fauna.

Endelig mener vi, at udviklerne er ansvarlige for, at de økonomiske interesser ikke overstiger ambitionerne for de grønne elementer i Jernbanebyen undervejs i udviklingen af området. Hvis udviklerne inddrager vores anbefalinger, aktivt arbejder for at ændre den styrende agenda i regimet og fastholder deres engagement til biodiversitet, mener vi, at de kan fungere som fyrtårn for hvordan, at biodiversitet bør inddrages i fremtidig planlægning af forurenede grunde i bæredygtige byer.

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First a special thanks to our supervisors, Arne Remmen & Stig Hirsbak for the helpful guidance, sparring and the many laughs throughout this final semester.

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Finally, a thanks given to the representatives from COWI, Danmarks Naturfredningsforening and Københavns Kommune.

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DEFINITIONS

BIODIVERSITY

Defined by the United Nations 'biological diversity' means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (United Nations Environment Programme, 2006).

BROWNFIELDS

"Brownfield is generally found in urban or rural areas, and especially the consequences are negative on the environment [1,2], which requires an intervention to reorganize it for beneficial use and to reduce pollution" (Zheng & Masrabaye, 2023, p. 1).

Environmental and urban sciences have demonstrated that brownfield challenges have a substantial impact on both human behavior and the environment. Understanding how to plan and redevelop brownfields sustainably can assist governments and financial partners to prioritize sustainable urban initiatives. Many brownfields redevelopment projects include sustainable components however, there are chances to advance sustainable brownfield redevelopment even further (Zheng & Masrabaye, 2023).

STAKEHOLDERS/INTERESSENTER

DSB Ejendomsudvikling, Team Cobe, Freja Ejendomme, Kommunen, Baneby Konsortiet

LANDOWNERS/GRUNDEJERE

DSB Ejendomsudvikling, Freja Ejendomme, Baneby Konsortiet

DEVELOPERS/UDVIKLERE

DSB Ejendomsudvikling, Team Cobe, Baneby Konsortiet

ZONING LAWS

A zoning laws, in Danish called 'lokalplan', is a form of legislation that governs how a piece of land or district may be utilized and is subject to the municipal plan, which describes overall guidelines, visions, and political goals for development of the city (Erhvervsstyrelsen, 2022).

TRACK FAUNA

'Track fauna', banefauna, is defined in the Planting & Biodiversity Strategy conducted by Metropolitan Metaculture (MeMe). Track fauna is the existing flora and fauna in the area, and MeMe's definition of this is:

"Nature type: Nutrient-poor and dry soils. The steppe, the overgrown, the rough and the pioneer forest. Quality: The existing and distinctive course flora and fauna. Self-grown nutrient-poor areas, from dry steppe flora to bright forest edges with birch and willow. Characteristic species: Willow, birch, pine, beaver aspen" (Metropolitan Metaculture, 2018).

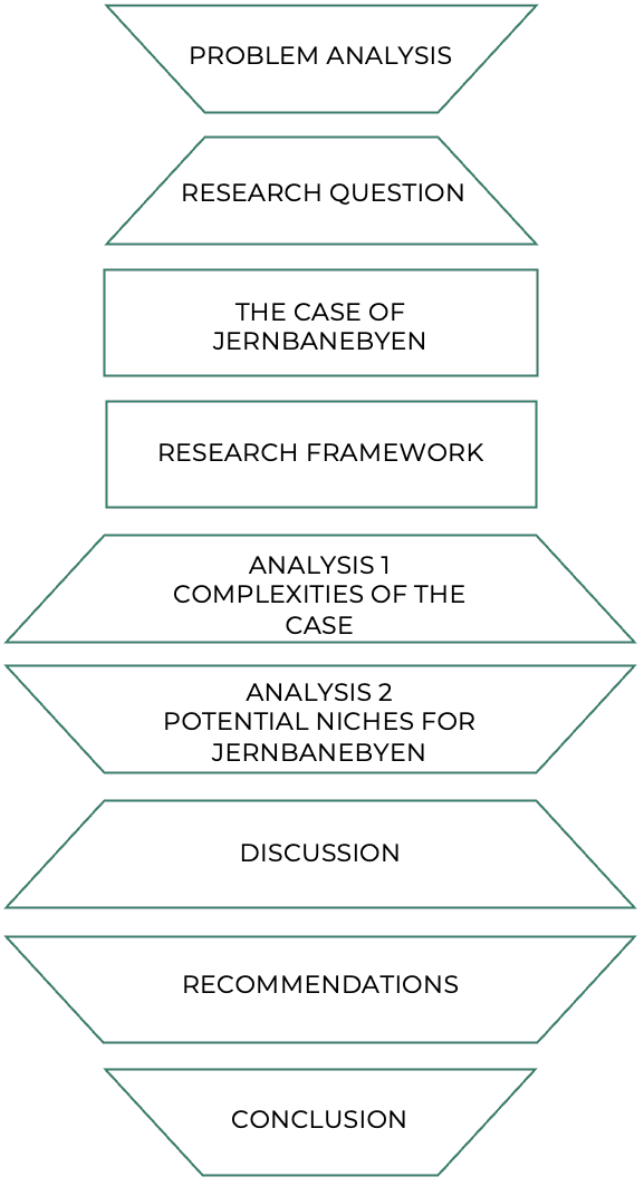
1 INTRODUCTION

“The biggest threat to biodiversity is our exploitation of the Earth's resources and space” (Rahbek & Manghezi, 2023).

This quote from Carsten Rahbek, Danish professor of macroecology, originates from a panel discussing at Danish Architecture Center which the thesis team participated in this spring of 2023. The overall message from the debate was clear, we must act on the biodiversity crisis now!

The global demand on our planet has risen for a very long time and: “*Rising human population and resource consumption are putting ever-greater pressure on the flora and fauna of our planet*” (Laposata & Withgott, 2015, p. 365).

For the first time in human history (since 2009), more citizens are living in urban areas than in rural areas. This historic shift from a nomadic hunter-gatherer lifestyle to a sedentary agricultural and urbanized one, may be the single most significant transformation our entire global society has ever seen (Laposata & Withgott, 2015). During this transformation towards urbanization, two objectives have been pursued: 1. making cities as livable as possible by providing residents with a safe, healthy, and clean urban environment, and 2. making urban areas sustainable by developing cities that can thrive and be resilient in the long run while reducing our ecological footprint and collaborating with rather than fighting against natural ecosystems (Laposata & Withgott, 2015).

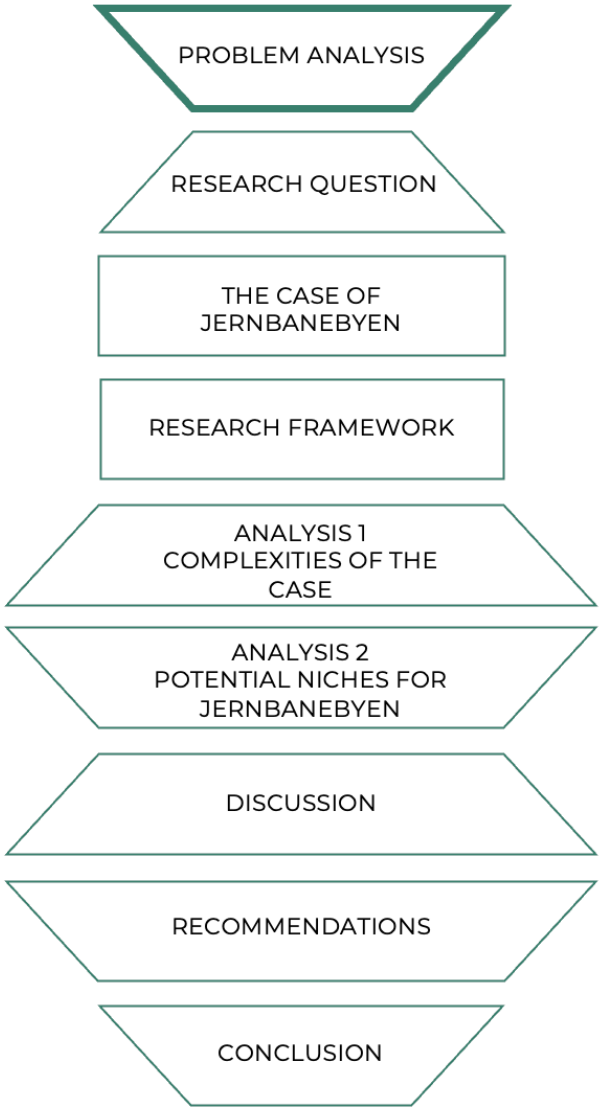


However, the effects of climate change on our cities will be numerous. Cities' capacity to provide for their residents will be impacted by drought, heat waves, shifting precipitation patterns, and changes in ecosystem structure (Robertson, 2014). Moreover, the climate and biodiversity crisis are two interlinked human-induced emergencies that are threatening the well-being of both present and future generations (European Commission, n.d.-d).
To prevent degradation in biodiversity and the deterioration of human life the interrelated aspects of sustainability challenges must be determined and policy, behaviors etc., must be changed. Further, a greater emphasis must be placed on the social and environmental dimensions such as nature and human health (United Nations Development Programme, 2017). To ensure the global goals of sustainability, the dimensions of sustainability; social, economic, and environmental, must be secured (Zimmermann et al., 2019) and further, the economic dimension, which for many years weighed the heaviest, must be changed.
Despite the beginning efforts seen by the UN, the EU, national governments, corporations and individual citizens, we need to acknowledge that the biodiversity crisis is not a problem that can be solved isolated, it demands interdisciplinary and cross boundary networks on all levels.

In this thesis we dive into the case of Jernbanebyen in Copenhagen, Denmark, a city development project determined to transform an old industrial brownfield with a long natural and cultural history into a multifunctional sustainable part of the city, where biodiversity is a part of their overall strategy. This research is executed to investigate how we can support their endeavor regarding biodiversity and examine if there is a paradigm shift emerging in the way we develop our cities, so that in the future biodiversity is further integrated in planning of brownfields.

Above figure illustrates the report structure and will be presented in the beginning of each section to indicate the position in the report and act as a simple reading guide. The different boxes are shaped as funnels to indicate the sections' relation to each other and to the theoretical framework of the thesis. The framework makes it possible for us to zoom in and out of the case and alternately narrowing and widening our perspective on biodiversity in urban planning to observe it in relation to biodiverse measures.

2 PROBLEM ANALYSIS



2.1 The biodiversity crisis

In the last couple of decades, the climate crisis has gained considerable attention. Sustainability and climate change have been almost synonyms, and greenhouse gas emissions are now a major concern for nations, businesses, and even individual citizens in their daily lives.
Unfortunately, the climate crisis has had the majority of the spotlight for a long time, leaving the biodiversity crisis in the background even though, biodiversity loss happens 100-1000 times faster (Miljøstyrelsen, n.d.-a) than any other point in human history. However, due to increased attention on the exploitation of natural resources in recent years (Rahbek & Manghezi, 2023), as a result of many years rapid economic growth, this may now seem to be changing the narrative.
A narrative that needs to be transformed since both climate change and biodiversity loss are challenges that affect economic development, security, society, morality, and ethics as well as the environment, and they must be tackled together. We as society have a responsibility to take the biodiversity crisis far more serious (WWF, n.d.). Therefore, basic knowledge about not only how deep a crisis we are in but also the underlaying causes are still something that needs to be spread to citizens and decision makers. Figure 1 is from WWF (with data from the Living Planet Report 2022) and illustrates the seriousness of the problem with species decline on a global scale.

BIODIVERSITY LOSS BY REGION

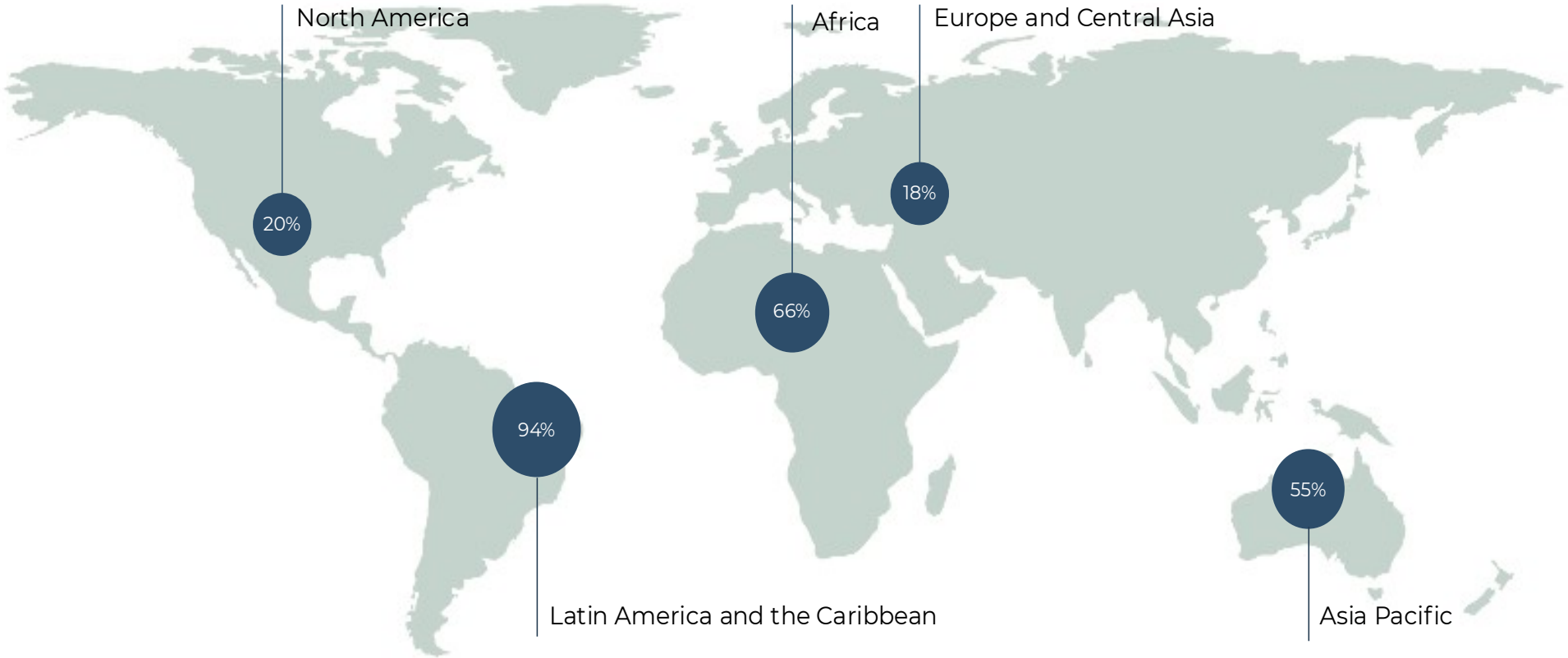


Figure 1 Own figure based on WWF's figure of biodiversity loss by region, showing decline in wildlife population from 1970-2018 (WWF, 2022b).

The concept of the nine planetary boundaries is research of resilience on a global level, focusing on the essential biophysical processes (Stockholm University, 2022a). In simple terms, it explores the extent to which the Earth's system can be perturbed without causing the system to change into an unhospitable state (Stockholm University, 2022b). Biosphere integrity examines the loss of biodiversity and extinction, and how societal needs are driving these changes (Stockholm University, 2022a). Therefore, the concept, based on scientific research and data, illustrates the importance and balance of biodiversity have on not only economics but humanity itself. As for now, the biosphere integrity has been estimated to have exceeded the boundaries' safety zone by far and is a high risk, as can be seen in Figure 2 (Steffen et al., 2015). Measures to strengthen ecosystem connections and improving habitats are therefore crucial (Stockholm University, 2022a) also in cities, as expansion of cities together with human actions are degrading the living conditions of many species and their habitats (Rahbek & Manghezi, 2023).

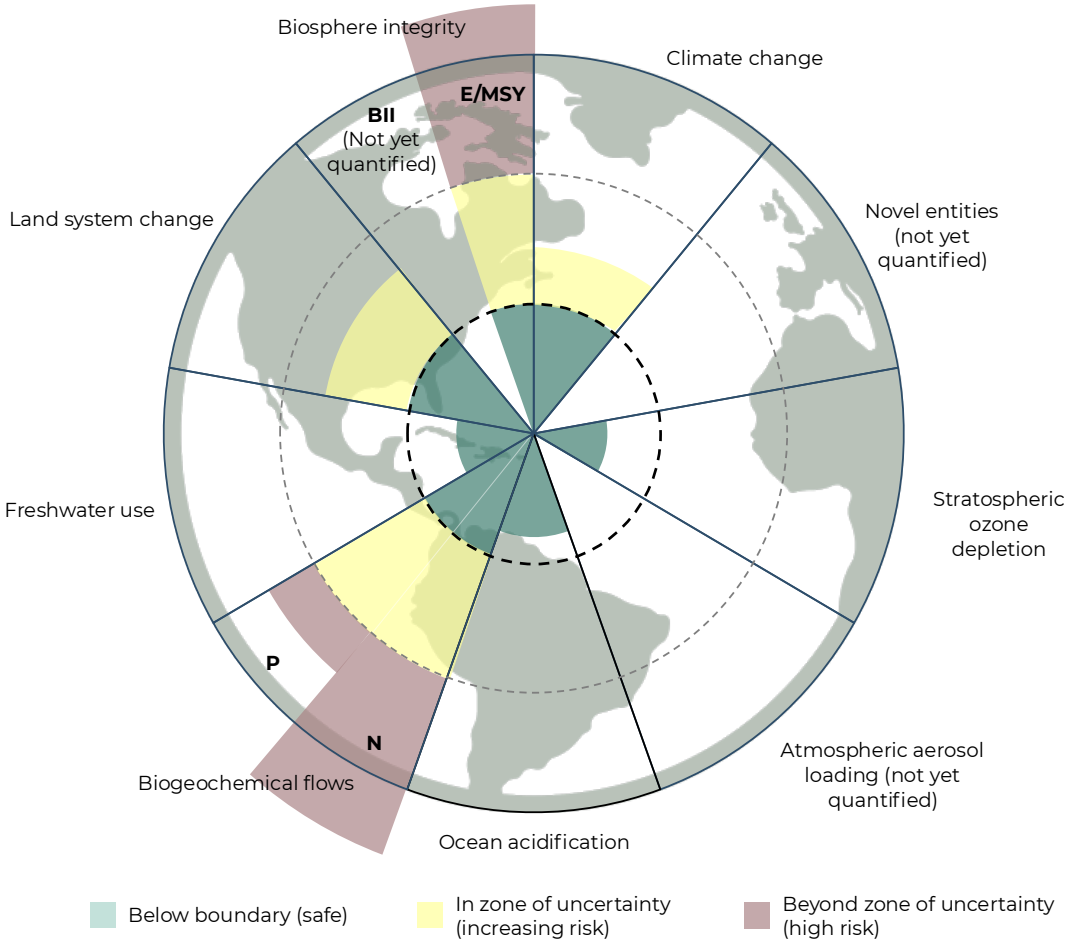


Figure 2 The nine planetary boundaries showing each categories state, where the green is within the safety zone (Steffen et al., 2015). *(Own figure)*

2.2 Global biodiversity threats

On a global scale, one out of the world's eight million plant and animal species are threatened with extinction (United Nations Environment Programme, n.d.-a). Unless action is taken to reduce the biodiversity loss, the global rate of species extinction will further accelerate. Already, the decline in biodiversity is faster than any time in human history (UN Environment Programme, 2022), and business-as-usual will only continue or worsen the decline (United Nations Environment Programme, 2021).
In 2015, the 17 Sustainable Development Goals (SDGs) were adopted by the United Nations (UN), which emphasize protection, restoration, and promotion of sustainable use of ecosystems and reverse of biodiversity loss (United Nations, n.d.-a). However, the world has failed to do this, and in 2022 the first global biodiversity conference in decades was held – the UN Biodiversity Conference (COP 15) (European Commission, n.d.-e).

The purpose of COP 15 was for governments from around the world to agree on "*a new set of goals to guide global action through 2030 to halt and reverse nature loss*" (UN environment programme, 2023b). Nature is critical to limit global warming to 1.5 degrees, and a framework to address nature loss is essential to secure the planet and human health and well-being (UN environment programme, n.d.-a).

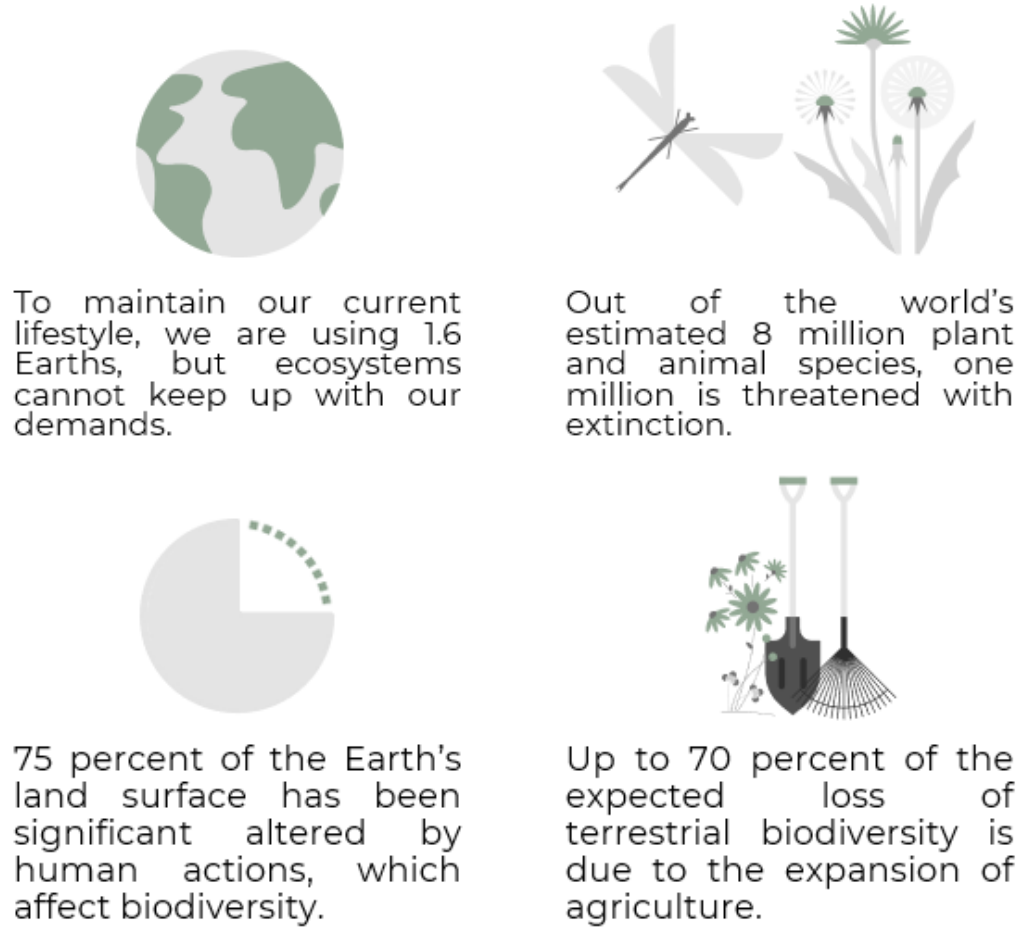


Figure 3 Facts on the nature crisis from (UN Environment Programme, n.d.-a). (Own figure)

Hence, the vision by the United Nations' *Post-2020 Global Biodiversity Framework*, signed by the members at COP 15, is to live in harmony with nature where "*by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people*" (UN environment programme, 2021, p.4). COP 15 emphasizes the need to change status quo and to equate the biodiversity crisis with climate change.

The global biodiversity crisis is degrading caused by human practices, and it has far-reaching consequences, Figure 3 shows facts about the nature crisis from the UN Environment Programme (UN Environment Programme, n.d.). Earth's biodiversity has seen an overall decline across the planet, and the Living Planet Index's tracking has shown an average 69% decline of monitored wildlife populations between 1970 and 2018 (WWF, 2022a). While the loss differs from region to region, five overall threats are closely connected to this (Environment, n.d.): *changes in land-use and sea use, species overexploitation, invasive species and disease, pollution* and *climate change*. Figure 4 showcase the five major threats for biodiversity.

Figure 4 Own figure based on information from "What Are the Major Threats to Biodiversity?" (Environment, n.d.)

2.2.1 Resource consumption

Human activity depletes natural resources and threatens biodiversity, and the world's ecosystems cannot keep up with our demands. Reality is that every year humanity uses more biological resources than Earth regenerates in one year (United Nations Environment Programme, n.d.-a). This has resulted in the globally known phenomenon *Earth Overshoot Day*, and already on July 28, 2022, the world had exhausted the Earth's annual resources (Earth Overshoot Day, n.d.). Resources which provide humans with food and clean water, and which our health and prosperity depend on (WWF, n.d.).

As natural resources are 'free', human tend to take it for granted, and it has been overexploited for too long. Human forget the benefits that are gained from biodiversity, and it must be reintroduced into urban areas for human to be remined of securing it (WWF, n.d.). Further, transformational changes are crucial to transform theory to practice as well as targets to values and rights both within policy and daily life (WWF, 2022a). The 2022 edition of the *Living Planet Report* (WWF, 2022a) settles that we are in the middle of a biodiversity crisis and have a final opportunity to act. The world needs to target for 'nature positive' meaning "*enhancing the resilience of our planet and societies to halt and reverse nature loss*" (World Economic Forum, 2021).

Land use change is currently the biggest threat to natural habitats, affecting plant and animal species on land, in freshwater and in the sea (WWF, 2022a). The expansion of agriculture is the main driver of deforestation, forest degradation and forest biodiversity loss, and conversion of forest to other land uses has since 1990 resulted in the loss of around 420 million hectares of forest (United Nations Environment Programme, 2022). In addition, climate changes such as rising temperatures are driving mass mortality and cause the first losses of species (WWF, 2022a).

Reestablishment of ecosystems can take decades or centuries depending on the type of habitat (Jones & Schmitz, 2009). Development of biodiversity depend on continuity in both time and space (Miljø- og Fødevareudvalget, 2021) and larger natural areas can better support populations of species and reduce the risk of degradation (Rahbek & Manghezi, 2023).

All ecosystems are affected by their surroundings, and replacement in the species composition can occur before the natural processes are reestablished, and the ecosystem is self-regulating (Miljø- og Fødevareudvalget, 2021, p. 7). Hence, the most effective solution to the biodiversity crisis is to ensure protection and management of existing nature.

Management of areas can be done through mapping and monitoring of ecosystems which provide collection of data for documentation and keeping tabs on the ecosystem's condition. Further, systematic monitoring and focused observation of biodiversity, allowing assessment and continuous documentation of ongoing changes in biodiversity, e.g., genes, ecosystems, functions etc.

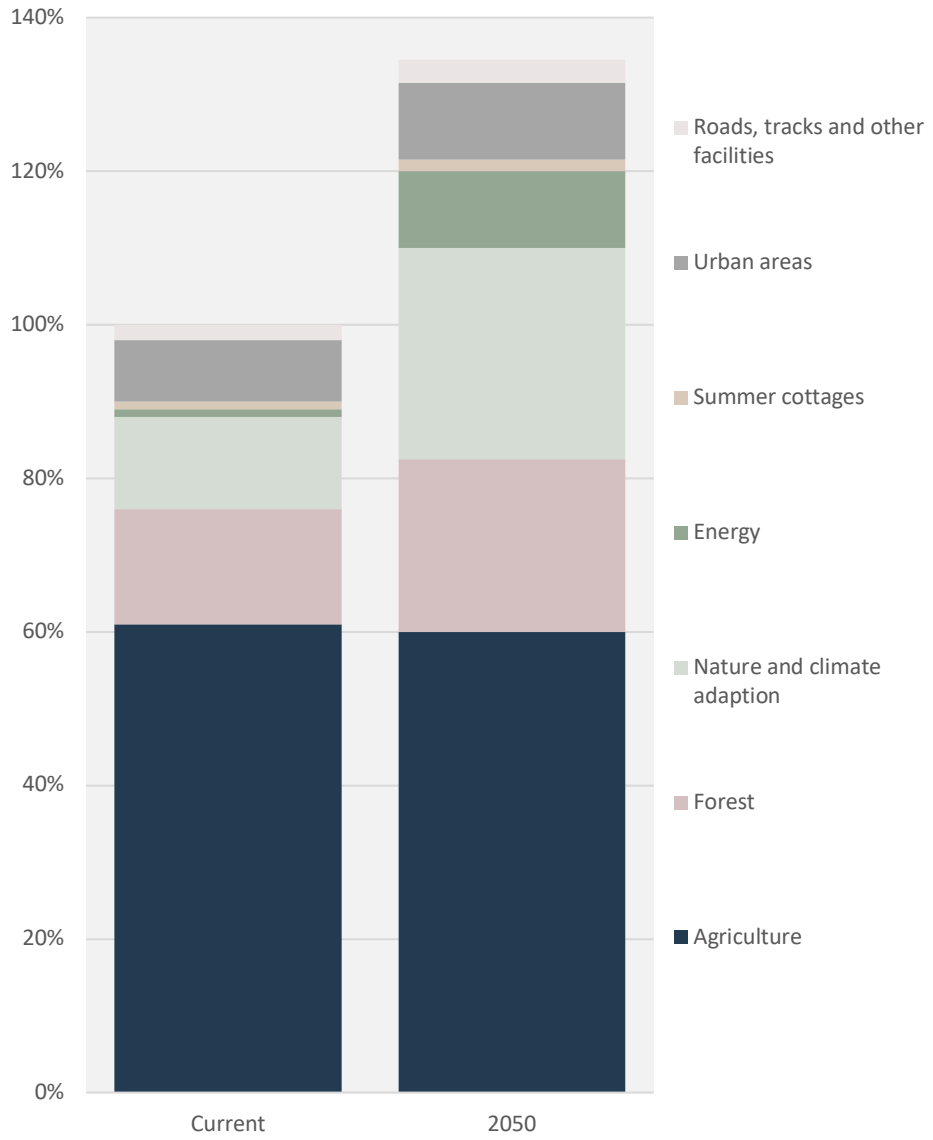


Figure 5 Diagram of land use development in Denmark based on information from the research "Prioritering af Danmarks areal i fremtiden" (Arler, Søgaard Jørgensen, et al., 2017). *(Own figure)*

2.3 Biodiversity in Denmark

On a global scale, Denmark is currently the second-most cultivated nation in the world. Regrettably, the country has the same bottom position on a European scale regarding the poor conservation status on the vast majority of species and habitat types, which are protected by the Habitats Directive (Ejrnæs et al., 2021).

Land withdrawal means that the habitats of many species disappear or are disturbed affecting species populations, genetic diversity, and existence (Miljøstyrelsen, n.d.-c). Research from 2017 shows that already today 100% of the land in Denmark is in use and assigned specific purposes (Arler, Søgaard Jørgensen, et al., 2017) of which agriculture constitutes more than half (Miljøstyrelsen, n.d.-c). Despite this, future visions and planned development of the country will exceed an unrealistic land use, that will require up till 130-140% of Denmark's area, Figure 5 (Arler, Søgaard Jørgensen, et al., 2017). The current limited space for nature is problematic, as to stop biodiversity loss, the most important thing is to give space back to nature (Greenpeace, n.d.). Small and scattered natural areas make it difficult for many populations of animals and plants to develop and reproduce across their habitats (Miljøstyrelsen, n.d.-c).

In 2020, research was done on biodiversity in Denmark where the country was divided into 9 ecosystems (Ejrnæs et al., 2021). The research and evaluation showed that out of 171 indicators for species, habitats, and processes, 51% are assessed to be in constant decline, while only 12% are assessed to be stable or improving. This

indicates that the Danish biodiversity strategy (Regeringen, 2014) following the UN's and EU's goals for biodiversity 2020 to ensure ending the loss of biodiversity was not successful in stopping the decline in Danish natural habitats.

Although there is a difference in decline between the 9 investigated Danish ecosystems, the decline was detected in all of them. The most severe declines were found for forest, grassland/heath and bog/meadow and least serious for coast, lake and sea (Ejrnæs et al., 2021). Making nature, biodiversity, conservation, and support for the growth of this as much a part of planning as other aspects is therefore essential. In addition, a new paradigm regarding biodiversity is crucial to rebuild biodiversity to secure 'nature positive' and further a better understanding of implementation of nature in urban development.

The alarming decline in biodiversity has made nature a need-to-have element in urban areas (Andersson et al., 2020). Targeted work with biodiversity in the city has not traditionally been in focus (Andersson et al., 2020), and in order to use nature-based design in urban development, we need to understand plants and trees functional interactions (Esbjørn, 2021). Classic-park landscapes with lawns and one-sided types of trees typically have a low biodiversity. Nature-based design, on the other hand, provides both biological, ecological, aesthetic, and social value. Hence, we must see nature as a positive collaborative partner (Esbjørn, 2021) and implement it to create a holistic picture of the biodiversity crisis that goes beyond recreational parks and green spots. Additionally, using nature's design principles can create diverse cities that meet the climate of the future (Esbjørn, 2021).

Despite the critical situation for biodiversity, the Danish society has recently begun to place a greater emphasis on this. More and more municipalities create space for species and habitat. Through a nationwide campaign, the country's 98 municipalities competed for a year and a half to become '*Denmark's wildest municipality*'. The winner became Vordingborg municipality, and the campaign resulted with the creation of several new networks across the board (Miljøministeriet, 2022).

The focus on biodiversity also gained attention, through the docu-series ''*Give us nature back*'' where the municipality of Hjørring participated together with the tv-famous farmer Frank Erichsen. The municipality carried out projects with participation from citizens, decision makers, business owners and farmers, and are followed over a one-year period to see, whether it makes a difference to do even the smallest things for biodiversity. Wild plants are incorporated for butterflies in suburban gardens and percentages of unusable farmlands are transformed into thriving habitats for all kinds of insects (Danmarks Radio et al., 2020). The results are uncanny – many minor actions all add up in the big equitation. The added publicity to the biodiversity crisis in Denmark creates a ripple effect, and it is therefore now the time to take it into account when planning cities.

2.4 Urban nature and urban biodiversity

This section will look at the relationship between the city and the natural world to understand how biodiversity and nature in cities are related.

The wording 'urban nature' must be understood as natural areas in the city. Nature is a broad concept and includes all living things as well as the resources, which are the basis of life i.e., water, soil, minerals, and sunlight. "*Nature in the city is thus also spiders in building corners, seagulls' nests on flat roofs and grass between the tiles. In the broadest sense, the city is them*" (Rambøll, n.d., p. 2).

Urban nature can be seen as a physical framework for an ecosystem where animals, plants, fungi, microorganisms, and humans live in harmony (Rambøll, n.d.).

Historically, nature and cities have been viewed as opposites. With as little human activity as possible, cities were for people, and nature belonged in the countryside. As a result, urban nature was not considered while developing cities and even now, there is little room for wild species in urban green spaces (Rambøll, n.d.).

The barrier between city and nature becomes blurred with the introduction of the concept of urban nature. Urban nature became about understanding and appreciating the city's natural values and designing urban areas with the goal of protecting and establishing habitats for both wild species and humans. Wild animals find adequate habitats on their own, but since we humans dominate the urban ecosystem, we also determine how many habitats there will be for other species. Thus, we have a responsibility to ensure no further loss of biodiversity and to give more room for adequate habitats for different species in 'our' urban areas (Rambøll, n.d.).

Own picture, Carlsbergbyen

A significant indication of living standards in cities is the amount of green spaces per resident (Mega, 2010). Green spaces in cities are often parks, which provide multiple different services for humans both such as recreative or climate adaptation such as rainwater basins.

“Green parks are the lungs of a city, the places where the natural and human-made environments interact. Maintaining green land often has to resist enormous pressure when the financial development cost of the land is very high” (Mega, 2010, p. 119).

Large central parks however might not be the most environmentally friendly option for cities. Many experts recommend smaller parks, even 'pocket parks', at a neighborhood level and untouched natural areas on the outskirts of cities to mark the border between urban and rural areas. Although, it is typically advised that initiatives focused on biodiversity have as much land as possible, pocket parks have the potential to be excellent examples of how biodiversity may be increased as their substantially smaller size makes them easier to administer (Miljøpunkt Østerbro, 2022).

Own pictures from parks in Copenhagen. From the left Biblioetekshaven, a Pocket in Carlsbergbyen and Enghaveparken.

The discourse of city planning has for many years had a huge focus on necessary investments in roads, utilities, and electricity cables – all the technology that is the prerequisite for a functional city (Thuesen & Grunkin, 2022). Mobility and infrastructure continue to dominate the planning paradigm. But, because of the biodiversity crisis there is a need to look at the value of urban nature from a new angle to see how the city benefits from nature's technical infrastructure (e.g., climate adaptation). In addition to its aesthetic and recreational value, which has a favorable impact on the climate, the environment, as well as people's health and well-being. This would ultimately result in an economic profit as well. 'Ecosystem services' is just one of multiple different concepts that can help to identify and measure the effects of new natural areas in the city (Laposata & Withgott, 2015). The concept can enable planners to consider the benefits we can get from incorporating more flora and fauna into the city. Further, it can give information about a specific area's condition including the formation of soil, the provision of food and fiber, the control of air quality and climate, the regulation of water supply and quality, and the aesthetic and cultural significance of specific plants and species. Due to this, the concept helps to assess whether the implemented urban nature supports and maintains biodiversity (Laposata & Withgott, 2015).

Urban nature can be implemented as part of climate adaptation solutions and aid the cities sustainable development. In Copenhagen for instance, this is seen in the neighborhood of 'Klimakvarteret Østerbro', see Picture 1, which is Copenhagen's first climate adapted neighborhood, primarily using sustainable drainage systems (SuDS) (Klimakvarter, 2013). The methods and expertise developed through the adaptation are meant to be used when implementing SuDS in the rest of Copenhagen (Københavns

Picture 1 Illustration of Klimakvarteret in Østerbro (Klimakvarter, 2013).

> *"The cities have many cultural species and introduced species that are part of the food chain together with wild species. Steep transitions from one area to another, surfaces, structures, height differences, light and shadow provides a structural character reminiscent of a hybrid between e.g., a mountain landscape, a forest and a light open meadow. Urban nature is therefore often not one specific nature type but hybrids of the existing nature types."* (Rambøll, n.d.)

Kommune, 2015) and future proofing against heavier rain and cloudbursts. The established, diverse planting, which serve as a rainwater collection system, promotes biodiversity for the entire area (Klimakvarter, 2013).

2.4.1 Brownfields

Many cities have exhausted their supply of 'virgin' land and thus do not have land available for further expansion. However, a result of structural changes of our societies is an increased amount of urban brownfields providing space to be revitalized for new uses. In short, brownfields play an important role in urban development (Lincoln Institute of Land Policy, n.d.).
Brownfields may include environmental and health risk and hence, redevelopment of these sites is complicated by a possible need for site decontamination (Lincoln Institute of Land Policy, n.d.). Further, the possible need to demolish old building structures makes development of 'virgin' greenfield land favorable (Umwelt Bundesamt, 2014). However, many brownfields redevelopment projects include sustainable components by which there are chances to advance sustainable brownfield redevelopment even further. Brownfields are often well integrated into existing infrastructures due to their previous use (Umwelt Bundesamt, 2014) such as seen with Jernbanebyen's location. By utilizing brownfields to settle more people inside the cities, more space is available for wild nature outside the city.

However, it is not only the space taken up by the cities but also the resource consumption within the cities that are being problematic (Rahbek & Manghezi, 2023). Hence, it is the overall consequences of urban development that must be the sustainable yardstick for biological diversity (Arler, Mosgaard, et al., 2017).

It is important to consider the unique potentials that the city has not only in relation to synergies but also regarding the rural areas and the forests. It also involves connecting the green spaces and giving them spatial structures, so that species exchanges can occur over larger geographic areas (Rambøll, n.d.). Finally, as most people live and work in cities, they are a particularly significant area of action for biodiversity. Through the introduction of nature in the city people will potentially gain more awareness of the essential need for nature to not only survive but also thrive. It further creates some unique opportunities to engage, educate, and inform people about the value of a rich and diverse environment.

2.5 Jernbanebyen

We will shed light on the potentials a city has towards nature and biodiversity through the project Jernbanebyen, which is an urban development of the former Godsbaneterræn in Copenhagen. The development of Jernbanebyen is from both the developers and the municipality with focus on creating green areas and preserving the site's biodiversity, and this will be reviewed more in depth in the case description in section 4.

"Jernbanebyen will contain all the best things about Copenhagen: squares and green areas where the citizens can meet, streets where you can cycle in groups, small and large businesses side by side, a world of old and new growing together. Contrasts, culture, and creativity. Neighborhoods with their own character. Cultural environments and car-free streets that intertwine with a unique mix of preserved buildings and modern architecture with a focus on sustainability. Communities about life in the city, in the street and in the yard. All that and much more is Copenhagen, and with Jernbanebyen we are writing the city's next chapter together" (DSB et al., n.d.).

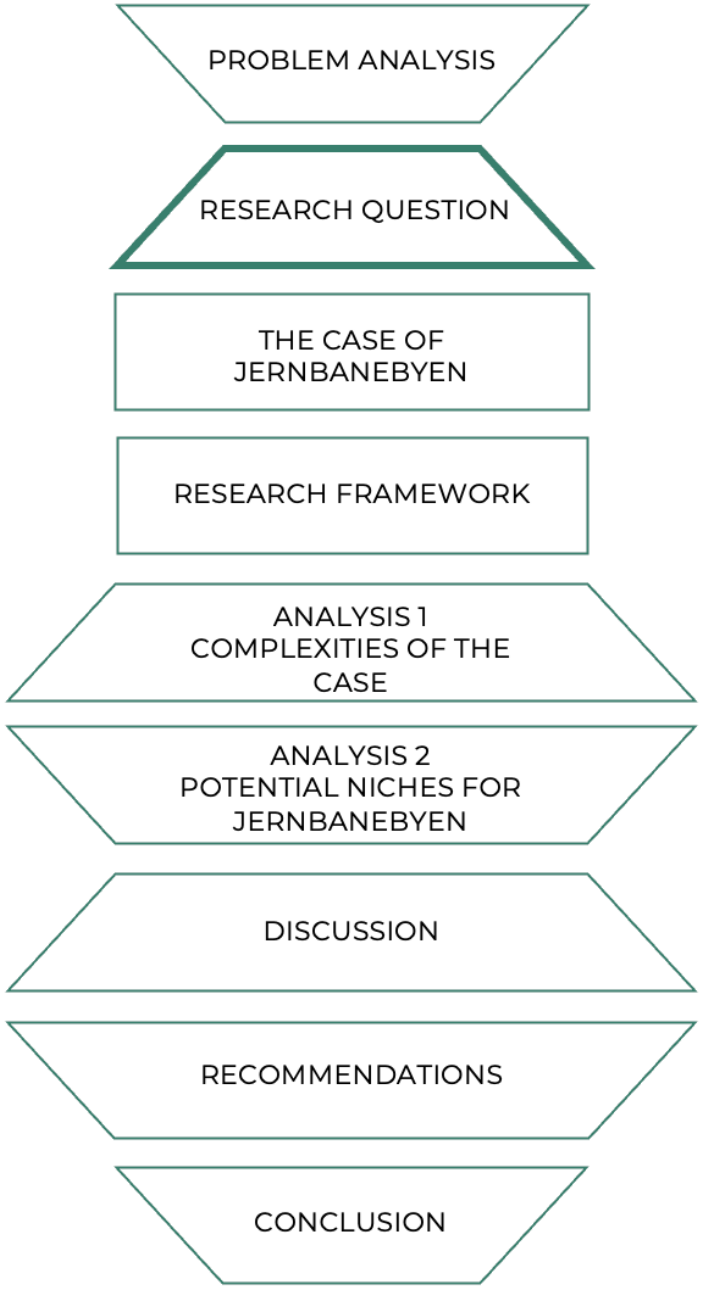
Jernbanebyen's stakeholders' visions for the area can be seen in the box on the left and is based around five main principles:

1. "*We want to build on the special culture, edge and creative powers already existing at the area of Jernbanebyen.*
2. *We want to create a green and urban district in the middle of Copenhagen.*
3. *We want to develop Jernbanebyen in a balance between city life and active communities and quiet everyday life.*
4. *We will develop a district based on climate-friendly and sustainable principles.*
5. *We want to develop Jernbanebyen together with the people of Copenhagen and together with passionate people and investors with a long-term perspective*" (DSB et al., n.d.).

3 RESEARCH QUESTION

The above problem analysis has explored how the biodiversity crisis requires the same level of attention as the climate crisis. It is clear that the natural world can live without human impact and involvement, but we as humans are deeply depended on all natural services the world provides for our survival.

Although the biodiversity crisis cannot be resolved in our cities (Rahbek & Manghezi, 2023), the cities do provide opportunities and synergies to raise awareness of flora and fauna and increase human involvement in finding solutions. It is therefore crucial that we consider how urban nature, climate adaptation and mitigation, biodiversity etc. can be incorporated in the beginning of the planning process of our urban development. The problem analysis states the need to examine the relationship between biodiversity and urban development and integrate solutions in this, and Jernbanebyen offers us a possibility for this. The case of Jernbanebyen is an opportunity to assess modern social trends and how the current demand for increased awareness of the biodiversity crisis is incorporated into urban planning, in an area where the zoning law is not yet completed. Especially with a focus on brownfields with contaminated soil e.g., industrial areas in the city. Additionally, it has an opportunity to demonstrate solutions that others can learn from and build on. Consequently, the following research question and sub-question have been explored in this report and by our research.



TO WHAT EXTENT IS BIODIVERSITY INTEGRATED IN THE URBAN DEVELOPMENT PROJECT OF JERNBANEBYEN IN COPENHAGEN? AND HOW CAN BIODIVERSITY BE FURTHER INTEGRATED IN THE FUTURE PLANNING OF BROWNFIELDS IN CITIES?

1. WHAT IS THE URBAN PLANNING PARADIGM THAT THE CASE OF JERNBANEBYEN IS POSITIONED WITHIN?

With this sub question we seek to understand the current landscape and regime that the case is placed within. We also attempt to understand our stakeholders' position, intentions and perspectives within the paradigm. This part of the research is centered around Jernbanebyen and the case itself.

2. WHICH SOLUTIONS CAN BE IMPLEMENTED AT THE SITE OF JERNBANEBYEN TO BOTH PRESERVE AND ENHANCE BIODIVERSITY IN THE AREA?

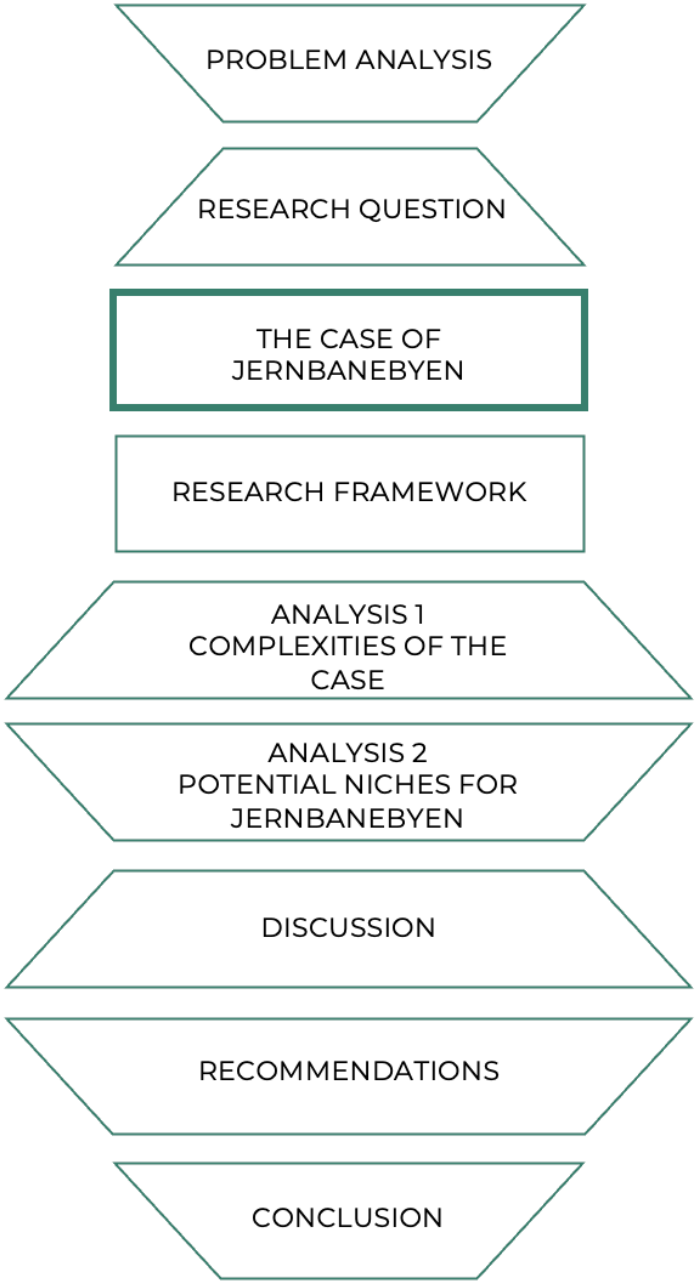
With this sub question we investigate niches that we find have potential to maintain and improve biodiversity in Jernbanebyen.
The niches presented are chosen based on the understanding we have gathered from our research, sub question one and our understanding of how to apply them in Jernbanebyen.

3. WHAT IS NEEDED IN THE CURRENT URBAN DEVELOPMENT REGIME TO SUPPORT A PARADIGM SHIFT AND A TRANSITION TOWARDS INTEGRATION OF BIODIVERSITY IN BROWNFIELD PLANNING IN CITIES?

With this sub question we zoom out from Jernbanebyen seeking to examine what is needed in the regime to further enhance the positive possibilities of biodiversity at the site of Jernbanebyen.
Furthermore, we discuss what is needed for a paradigm shift to establish a regime where biodiversity is a top priority when planning and developing brownfields in cities.
Finally, we seek to discuss if and how Jernbanebyen has the opportunity to become an example of how to do this.

4 THE CASE OF JERNBANEBYEN

This section will introduce the case of Jernbanebyen, from which our report is based. The section will include a historical overview of the development of the future Jernbanebyen up until today, a description of ownership, and relation to neighbors. Further, the architectural competition regarding the master plan of the area prior to the development of Jernbanebyen is described. The master plan forms the framework and visions to be implemented in the zoning law. The master plan's visions are based on green elements and recreation as well as preservation of many of the area's old buildings. In addition, the different stakeholders involved in the development process are described.



4.1 Jernbanebyen

Our project is based around the case of Jernbanebyen, a total area of 365,000 m^2 for urban development, which will be located between Vasbygade, Enghavevej and Ingerslevsgade in Copenhagen, shown in Figure 6 (Jernbanebyen, 2023).

The plan for the former industrial area is to change it into a modern district, with housing, businesses, retails, institutions, a school, public transport, and green areas (Licitationen, n.d.). The landowners' primary aim is to create a sustainable urban area containing all the best elements of Copenhagen (Jernbanebyen, 2023).
The area was included in the Municipality of Copenhagen's *Municipal Plan 2019* and appointed as one of the areas for development of green areas in the city (Københavns Kommune, 2019). Further, the municipality has a wish for the development of the district of Jernbanebyen to become a 'lighthouse' example for how the city in the future will develop with the focus on green elements (Københavns Kommune, 2019).

The case of Jernbanebyen is therefore relevant to examine in this research, due to the perspective and prioritization of green areas in the planning process for the future landscape.

4.2 Historical use of the area

The location of the future district of Jernbanebyen in Copenhagen, has formerly been known as Godsbaneterrænet - the freight railway terrain. The area therefore holds historical elements which have preservation and cultural values (see also section 7.2.3) for locals and administrable parties (Freja Ejendomme & DSB Ejendomsudvikling A/S, 2020), and the landowners and the municipality aim to stay true to its identity and base the future environment on this (Københavns Kommune, 2019). The below timeline is based on information from the area's website (Jernbanebyen, n.d.-b).

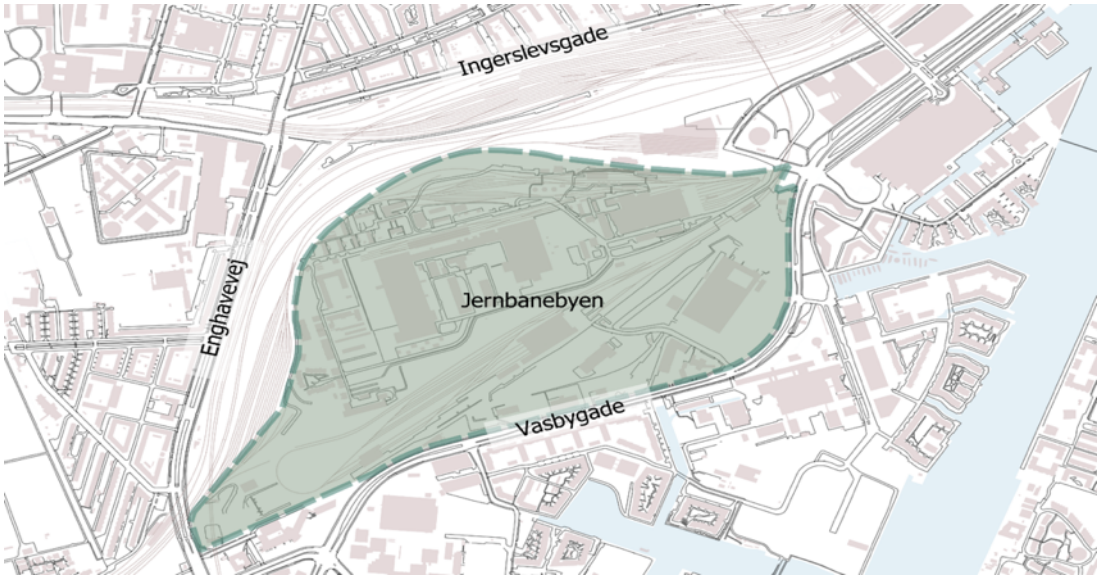


Figure 6 The area of the district of Jernbanebyen is marked with green. (Own figure)

4.2.1 *The historical timeline of Jernbanebyen*

1895
Until the end of the 19th century, the area constituting Jernbanebyen was seabed and flooded salt marshes. In 1895, a large filling work of Kalvebod Strand begun and a new freight station and railway workshop were to be built.

1901
Danske Statsbaner (DSB) open the new freight station and thus the development of the area where Jernbanebyen is located begins. In adjacent to the freight station a larger depot was built.

1909
The railway is developing rapidly, and DSB opens its new large central workshop, *Centralværkstedet*. Den Gule By is built and consists of 32 residences for employees at the DSB emergency vehicle service.

1939
At the central workshop, a lighting train lifting hall is built for repair and maintenance of the 'Red Lightning Trains'. The trains were deployed in 1935 in connection with the opening of Lillebæltsbroen.

1958
With the purchase of the new diesel locomotives and abolition of steam locomotives, the establishment of up-to-date machine depot facilities at the location begin. Parts of the depot from 1901 is demolished and a new depot buildings erected. The first stage of the modernization was completed.

1964
As part of a large-scale reconstruction and modernization, a new customs warehouse is built at Vasbygade. Meanwhile, a workshop, garage, truck workshop and Toldpakhuset is built in the area. The surplus areas is leased to companies in need of company tracks for the transport of goods.

1970
With the introduction of containers for freight transport, there is a need for container terminals, where containers can be transferred from rail to road, is established. In the 1980s, the container terminal was expanded into a combined terminal for road/rail combined transport

2000
DSB (DSB Gods) ceases freight transport by train. DSB sold a big share to Danske Fragtmænd, and the rest was sold in 2001 to Railion-corporation.

2005
The combi terminal ends and the area is handed over to Metroselskabet in 2008 for a preparation center for the Metro City Ring.

2009
DSB rents out vacated railway buildings at Centralværkstedet to office communities, entrepreneurs, creative souls etc. DSB's maintenance facilities are gradually being moved to railway workshops elsewhere in the country.

2018
In September, Oehlenschlægersgades Skole at Vesterbro moves into Jernbanebyen in temporary pavilions due to extensive renovation.

2019
The landowners, DSB Ejendomme and Freja Ejendomme, announce in May the new name of the new district, *Jernbanebyen*.

2020
Jernbanebyen is adopted in Copenhagen's Municipal Plan 2019, enabling the development of the area. For developing a zoning law for the area, the landowners launch an architectural competition, making a master plan. In September, students move into the temporary CPH Village.

2021
Team Cobe wins the architectural competition in April. In October, it is announced that Freja Ejendomme has sold their share of Jernbanebyen to Baneby Konsortiet.

2022
The development of the zoning law for the area is in the works.

2023 -
The zoning law is still being negotiated with the municipality and expected to be finished and approved in the turn of the year 2023/2024. After which the construction of Jernbanebyen begins.

TIMELINE

4.3 The development process of Jernbanebyen

The development of Jernbanebyen began with a request by the landowners wanting to include the area as an urban district in the *Municipal Plan 2019* (Københavns Kommune, 2022c). This was approved by the publication of the *Municipal Plan 2019*, as a new urban development in the district of Vesterbro (Københavns Kommune, 2019). Since then, there has been a collaboration between the municipality and the landowners to develop a zoning law for the area (Københavns Kommune, 2022c).

4.3.1 Ownership

Originally, the 365,000 m^2 area of Jernbanebyen were owned by Danske Statsbaner (DSB) Ejendomsudvikling and Freja Ejendomme. DSB Ejendomsudvikling's share was 287,000 m^2 of the land, and Freja Ejendomme owned 78,000 m^2 (NREP A/S, 2023).

DSB Ejendomsudvikling's interest in developing the area is due to financial aspects, as renting out the buildings in the area will eventually contribute to financing parts of the train operation (Gleesborg, 2023). However, DSB Ejendomsudvikling is a public corporation that runs train operations and is not allowed to put money aside for urban development however, they are able to contribute with their share of land to then together with a partner develop Jernbanebyen (Gleesborg, 2023). Therefore, in this process, in 2021, Freja Ejendomme made a conditional agreement to sell their share of land to the consortium Baneby Konsortiet, which consists of the pension company Industriens Pension, the real estate company NREP and the holding and investment company Novo Holdings, see Figure 8 for information on these partners (Industriens Pension, n.d.-b; NREP, n.d.-b). The condition for this agreement is the approval of the municipality's zoning law (Gleesborg, 2023).

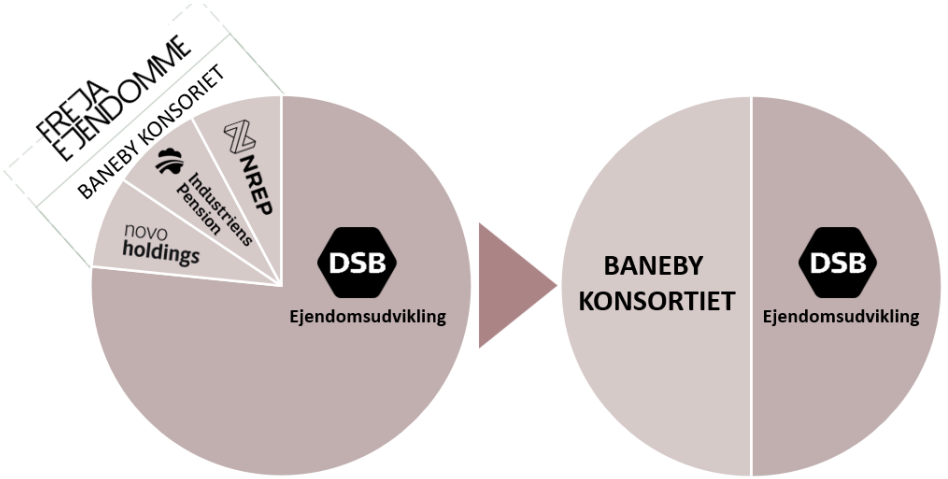


Figure 7 Own figure of ownership division of the land area of future Jernbanebyen, from original division to future division where DSB Ejendomsudvikling and Baneby will own 50/50.

Further, an additional detail to this agreement is a joint-venture agreement where the consortium together with DSB Ejendomsudvikling will become 50/50 partners of Jernbanebyen (NREP A/S, 2023). In this agreement DSB Ejendomsudvikling contributes their land, and the consortium contributes money and their share of the land bought from Freja Ejendomme (Gleesborg, 2023). As a result, Jernbanebyen will henceforth be developed

under a joint-venture partnership between Baneby Konsortiet and DSB Ejendomsudvikling (Gleesborg, 2023).
In 2020, before the sale of Freja Ejendomme's share of land, an architectural tender for a proposal for the master plan of the area was arranged (Freja Ejendomme A/S et al., 2020). This tender was done through an architectural competition in the form of a parallel assignment with five interdisciplinary teams (Jernbanebyen, n.d.-c) and won by Team Cobe in April 2021 (Jernbanebyen, 2021). Team Cobe is composed by the companies and stakeholders; Cobe, Arcgency, Urban Creators, COWI, 103 Rådgivende Ingeniørselskab, Metropolitan Metaculture, Mark Vacher and Sandra Lori Petersen (Jernbanebyen, 2021). The team's role is to form the area and to provide data and knowledge in the process of establishing a final district plan for the area.

Since 2021, Team Cobe together with the landowners has prepared a proposal for a master plan for the area (Gleesborg, 2023) laying the basis of the initial statement for Jernbanebyen submitted in 2022 (Københavns Kommune, 2022b).

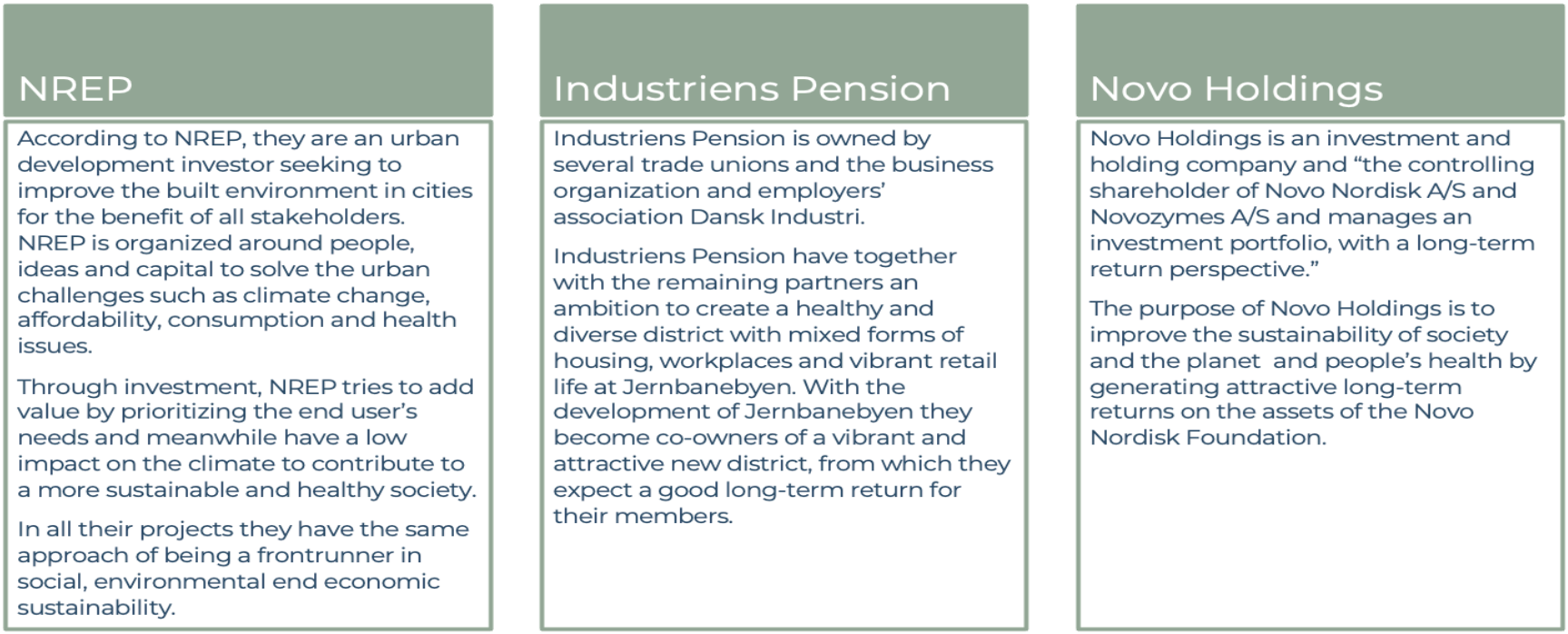


Figure 8 The buyers of the Freja Ejendomme's share of land, and partners of Baneby Konsortiet (Industriens Pension, n.d.-a; Novo Holdings, n.d.; NREP, n.d.-a, n.d.-c).(Own figure)

Finally, the process of forming the final zoning law is still ongoing. In this process, the municipality plays an important role, as they have a big responsibility in the negotiation of requirements and must approve the set plan. The landowners DSB Ejendomsudikling and Baneby Konsortiet together with Team Cobe have therefore entered a new collaboration and negotiation process with the Municipality of Copenhagen, the local councils, neighbors, and other stakeholders in an open and inclusive process regarding the zoning law (Industriens Pension, n.d.-b) The final zoning law for the future Jernbanebyen is expected to be finalized in the turn of the year 2023/2024 (Københavns Kommune, 2022b), and the turning of the first sod is expected in the fall of 2024 (Gleesborg, 2023).

Zoning laws are a form of legislation that governs how a piece of land or district may be utilized and is subject to the municipal plan that describes overall guidelines, visions, and political goals for development of the city. Municipalities are required to establish zoning laws in areas that are to be developed or in areas that have not previously been regulated. If there is a wish to change the use of an area and implement infrastructure or construction, which do not comply with the existing zoning law, a new zoning is required to be adopted by the municipality (Erhvervsstyrelsen, 2022). Urban development as well as establishing and renewal of zoning laws attend to accommodate societal needs, and it is therefore seen as a democratic process. In Denmark, zoning laws are subject to higher ranking legislations and definitions for land use on municipal and national levels (Erhvervsstyrelsen, 2022). The process of carrying out and establishing a zoning law from municipality to municipality in Denmark are comparable and can roughly be summarized and illustrated as in Figure 9.

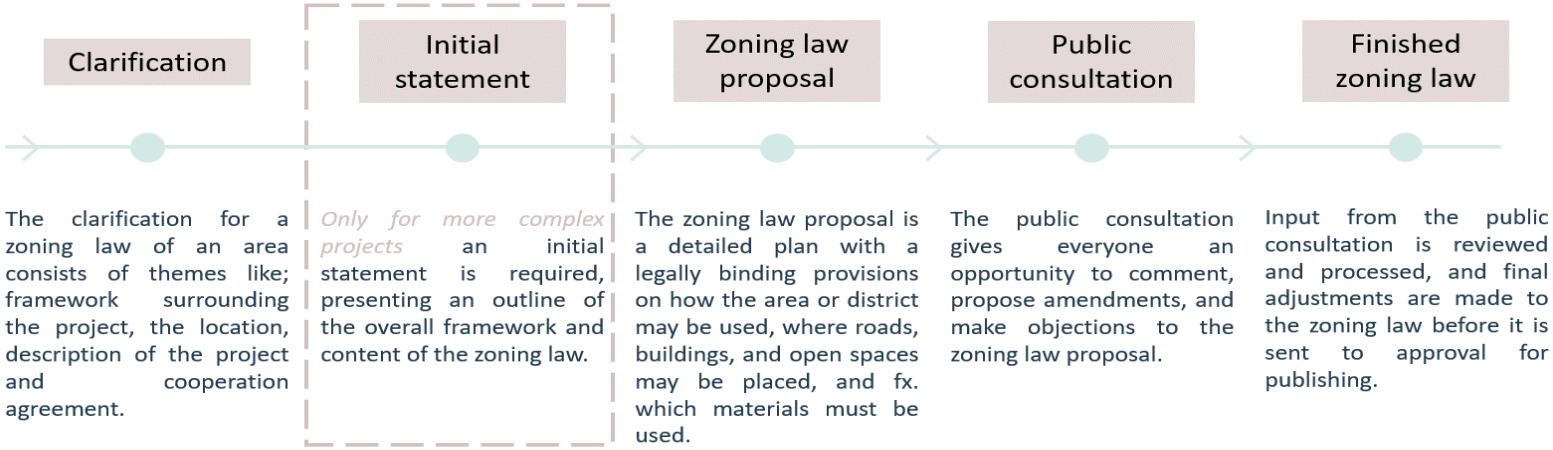


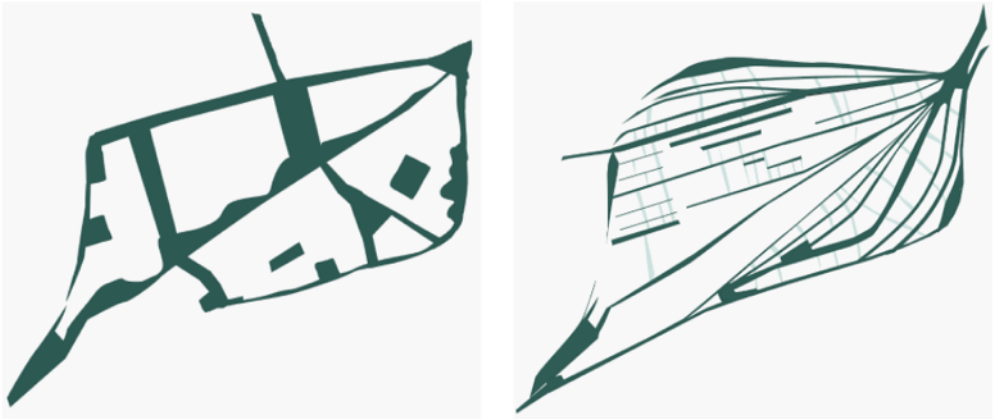
Figure 9 Own example on summary of the process of establishing a zoning law, compared across several municipalities.

4.4 Jernbanebyen in the future

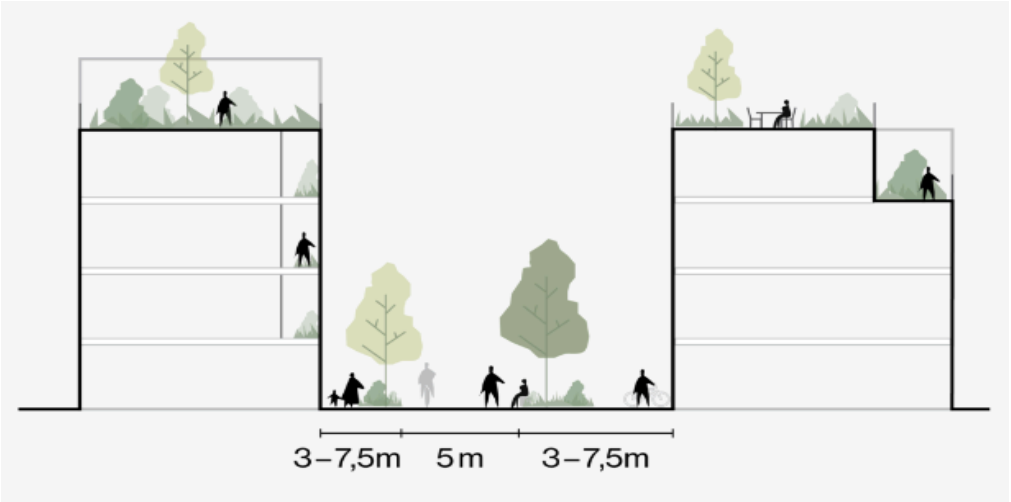
As mentioned, the master plan conducted by Team Cobe lays the baseline for the preliminary strategies for layout of the area included in the initial statement (Københavns Kommune, 2022c). This layout is also the baseline which is negotiated in the process of preparing the final zoning law.

The construction of Jernbanebyen constitutes the last major piece of urban development in southern Copenhagen (Jernbanebyen, n.d.-d). The name Jernbanebyen is selected due to its reference to the area's history and it being part of something bigger (Venset, 2023), and several buildings on the site are selected by the municipality to be worthy of preservation (Gleesborg, 2023). The rare and heritage listed buildings on the site will be transformed into spaces for creative businesses and startup companies (COBE, n.d.).

The plan is that existing buildings will be renovated and rebuild, and materials reused while the area will be expanded with further construction (Jernbanebyen, 2023). An example is 'Centralværkstedet', which will become a "*pulsating heart that is activated throughout the week by children and young people, workers and residents, and by visitors to cafés and workshops*" (Cobe et al., 2021, p. 38), and the existing buildings are reinforced by new buildings (Cobe et al., 2021). In the northern part, several buildings have a potential for culture, creativity, business, and an active everyday life to merge and the southern part, on the other hand, is characterized by undeveloped areas (Jernbanebyen, n.d.-a).



Picture 2 The strategies 'Green spaces' (Grønne frirum) and 'the Weave' (Vævet) developed by Team Cobe for Jernbanebyen (Cobe et al., 2021, p. 6)



Picture 3 Example illustration made by Cobe for future roads of Jernbanebyen. The roads are limited to only 5 meter in width to create more space for urban life and nature (Cobe et al., 2021)

The overall area is also characterized by a period of resting, self-grown plants, and old trees, and in the master plan for the area these elements are wanted to be protected and strengthened (Cobe et al., 2021). In the future vision, as can be seen in Picture 2, nature will be a connection between the area's neighborhoods (Jernbanebyen, 2023).

In Jernbanebyen all residents will be living in proximity with nature, and pedestrians and cyclists will be given the priority (COBE, n.d.), where the green spaces will contrast with the historical industrial buildings and trains tracks. The vision is a partially car free district, which will contribute to an active life and create space for local meeting places and urban nature, as traditional street areas will be reduced by up to 50%, see example on Picture 3. A reconstruction of the typical urban area will create a pleasant city climate and possibly increase biodiversity (COBE, n.d.).

Own picture, Jernbanebyen

4.5 Jernbanebyen's neighbors

Neighbors within the future area of Jernbanebyen constitute the Metro's Preparation Center and Den Gule By, while smaller areas are owned by the Municipality of Copenhagen and HOFOR (Duus, 2021).

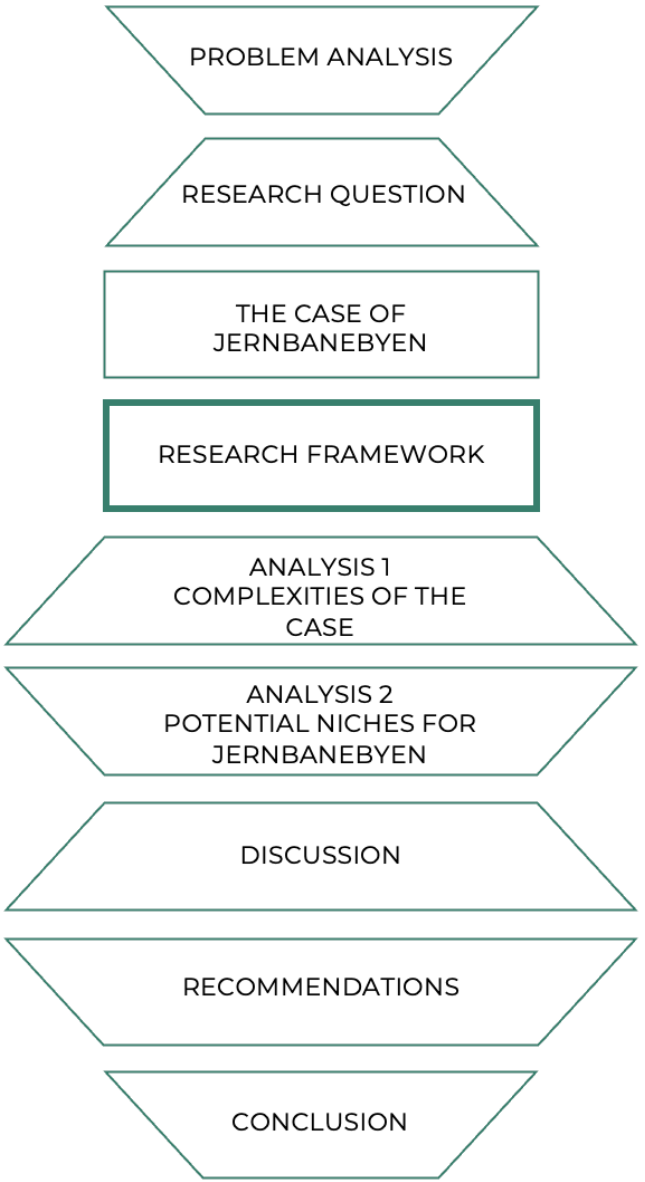
Further, Jernbanebyen will be part of the district of Vesterbro, and the local committee of Vesterbro is taking part in the development (Gleesborg, 2023). The committee and many citizens in the area around Jernbanebyen have for several years expressed interest in developing the area into a recreational area with respect to its history and as a benefit for the citizens of Vesterbro (Københavns Kommune, 2010). The landowners give priority to such collaborations, as it helps to ensure a good relationship with their neighbors (Freja Ejendomme & DSB Ejendomsudvikling, 2020) in order to secure a good reputation of Jernbanebyen and create a positive vibe and attraction to the area from the beginning. Thus, the landowners together with Team Cobe have introduced temporary initiatives in the area including student housing and regularly hold city walks in the area (Schønherr & Ballegaard, 2023). Furthermore, DSB Ejendomsudvikling holds citizen's meetings while still working on the zoning law with the Municipality of Copenhagen (Gleesborg, 2023).

Own picture, Vesterbro

5 RESEARCH FRAMEWORK

The project's research framework is presented in this section including our pragmatic approach, which helps us to continually reflect on the knowledge gained and to further understand and investigate interconnected wicked problems. The section outlines how our agenda is situational and action-based, as by using semi-structured interviews and continuous dialogue we aim to obtain a deeper understanding of the issues at hand and the stakeholders. Through 'condensation of meaning', we have found content and themes in our interviews, which are further processed in the analyses, where the interviewee's statements in accordance with the issue observed is analyzed. In addition, with applied research for our case study we are able to create a proposal of solutions to the real-world problems entailed at Jernbanebyen.

This will support our research of a potential paradigm shift regarding planning of urban development projects for brownfields. The stakeholders involved at Jernbanebyen operate via different ideologies and agendas, which affect their actions. Hence, with the multi-level perspective we explore the planning regime that the stakeholders are positioned within, and which governs their possibilities and defines the planning hierarchy. This will further be elaborated in the research framework as well as our approach to the literature and document analysis.



5.1 Theories of science

5.1.1 Paradigms

Science theorist Thomas Kuhn developed the phrase 'paradigm shift' to describe how different scientific theories gradually take the place of one another. The theory holds that there are consistently a number of dominating schools of thinking also known as paradigms, which are accepted by most specialists in the discipline. "*Kuhn talks of normal science as puzzle-solving, because problems are to be solved within the terms of the paradigm: failure to solve a problem usually reflects badly on the researcher, rather than on the theories or methods of the paradigm*" (Sismondo, 2010, p. 14).
Throughout time, new competing paradigms appear that are better able to address the scientific problems that researchers are encountering. After some time of coexistence, the advocates of the new paradigms grow, and a paradigm change is made possible.
Further, sociotechnical experimentation with unique configurations of technologies or services in distinct local contexts is essential to altering the paradigm (Holm et al., 2014).

Kuhns ontology is based on paradigm dependent experiences, and we as researchers are therefore paradigm dependent problem solvers (Sismondo, 2010). Paradigm dependent truthmaking makes it difficult to be pragmatic, but to examine possible new trends in regimes and a paradigm shift we are using a pragmatic approach to understand our problematic situation (ensuring biodiversity in Jernbanebyen). Thus, our position as researchers is that we are engaged with our research object actively and are gaining knowledge through experimental experiences. The pragmatic approach does not care about the one and only truth (Dewey, 2006). There is no need to discuss the truth, if it is not useful for our conducted research. Pragmatism makes it possible for us to use all tools, methods, and theories to understand and solve the problem at hand (Thurén, 2008).

Kuhn's thoughts about tactic knowledge (Kuhn, 1969) assist us with our decisions on recommendations, as besides our current research we are using knowledge and abilities gained over time that we cannot exactly pinpoint where we got. Intuition also plays a huge role in decision making, but it is not something that is researched, it is evolved (Thurén, 2008). Logic and our research will be the base of our decision making however, as we are deeply invested in the project and have our own agenda, we need to be transparent about how our previous experiences play an indirect role in the final recommendations.
Nevertheless, some of the criticism of pragmatism centers on how challenging it is to do transparent research, as all tools and concepts can be applied (Kaushik & Walsh, 2019). It is thus difficult to genuinely be neutral, according to Kuhn, even though this is a dominant discourse in the academic community (Kuhn, 1969). Whether we like it or not, we are all part of a paradigm and must explain our perspective and position in our study. Kuhn further argues that even if it is very challenging, we should endeavor to question our own paradigms. We should be as translucent as possible and flag our traditions in our preferred theories and methodologies (Thurén, 2008) .

5.1.2 A pragmatic approach

The primary premise of pragmatism is that knowledge is fundamentally tied to human activity. Rather than existing as a traditional theory of science, pragmatism is more of a philosophical tradition based on the idea that people acquire knowledge through their actions (Dewey, 2006). The founding principle of pragmatism is that questions and answers should be based on practical considerations. As a result, one should ignore ideas or concerns that have little to no potential value in favor of clearly defined research with practical applications (Dewey, 2006). With a pragmatic approach, the methods and theories that should be used to analyze problems are left up to the context and circumstances (Gimmler, 2018).

This epistemological perspective has allowed us as researchers to employ a variety of techniques to comprehend the complexities of Jernbanebyen and their 'green' aspirations for the area. Since pragmatism permits a variety of diverse explanations and approaches, it can be seen as ideal for describing complicated problems. A pragmatic approach's ability to comprehend fundamentally complicated problems is demonstrated through examination of so called '*wicked problems*'. Wicked problems are complicated and interconnected issues (Roberts, 2000), they often have unclear goals and solutions, as well as being hindered by many actors and practical limitations that prevent easy-fixes and straightforward attempts to solve them (Roberts, 2000). Sustainability issues can be viewed as strong examples of wicked problems due to their inherently complex nature, where various stakeholders' perspectives and goals on the matter often lead to a variety of opinions and definition, making it much harder to agree on solutions and progress. A pragmatic strategy offers a helping hand to understand and investigate wicked problems, as researchers continually can reflect on the knowledge gained, can rethink the tools used, add new methods if needed, and iteratively look at the recommendations and possible solutions for the problem.

An ongoing dialogue with the different actors (see Table 1) involved within Jernbanebyen has continuously made us reflect on the methods described in this section and apply them where needed to offer a deeper understanding of the specific issues at hand. A proactive, continuing investigation of issues is necessary for pragmatic thinking, as it is situational and action-based (Brinkmann, 2006). Hence, pragmatism demands that all viewpoints have some connection to actual life and activities and that all problems, ideas and solutions have a real-world application.

Our beliefs and current regime have persisted for so long that it has also become the paradigm from which we develop cities (Holm et al., 2014). A change of the regime can happen through a changed landscape, as this will cause gaps and room for innovation as well as a paradigm shift that will affect the regime (F. W. Geels, 2002). The parties involved in the development operate via various ideologies, paradigms, and agendas that all form how they act within the project. However, most of the stakeholders are part of the same regime defined through the multi-level perspective (MLP), as the hierarchy that governs the planning process is determined.

The focal point of MLP is to understand how innovations emerge, and how they over time replace the existing regime causing systematic change, and a transformation of the current paradigm (Geels, 2002).

5.1.3 Multi-level perspective

The multi-level perspective constitutes of three levels divided into the *socio-technical landscape*, the *socio-technical regime* and the *niche-innovations*. The landscape represents heterogeneous factors as the overall environmental related challenges and cultural and normative values involving the biodiversity crisis, economic growth, energy crisis or the current war in Europe etc. (F. W. Geels, 2002).

The regime constitutes of rules that both restrain and enable activities within communities and usually only generates incremental innovations. Though, for changes to occur within the regime a window of opportunity for transitional change must be created. Slow changes of the landscape disrupt the existing regime causing destabilization, which creates opportunity for change and for niche-innovations to emerge and become part of the regime or partly replace it. But radical niche-innovations must have difficulties to break through the regime, as it must pass through the different levels of MLP (Geels, 2002).

Furthermore, niches can be explained as "*places for innovation, not only of new technologies, but also in the form of new constellations of fields, technologies, agendas and innovative regulations/institutional frameworks*" (Holm et al., 2014a, p. 45).

5.1.3.1 Transition

An important point of MLP is that success of a transition is not only governed by the niche-innovation but by development of the existing regime and the landscape. However, the innovations provide seeds for change and are crucial for transition (F. W. Geels, 2002). Top-down steering by governments cannot alone tackle global problems, and new agents must be mobilized. A process of transition within the regime must be done by policy makers, firms, industries, the civil society, engineers etc., and it is associated with a shift in emphasis from 'government' to the broader concept of 'governance' (Asquith, 1994).

Transition is a comprising, complicated and long-term process. The complexity of transition is due to the differing elements in a transition being connected and aligned to each other, and the process of integrating and adapting innovation into user practices, organizations, regulations, and routines (F. W. Geels, 2002). In addition, the stakeholders' different paradigms, which they act through and their problem solving depends on, also contribute to the complexity.

The regime is affected by truth, and we thus use the pragmatic approach to understand how it is possible to challenge the existing regime. If the current understanding of truth is not challenged, niche-innovations cannot emerge and replace segments of the current regime. However, replacement is necessary if the world is to minimize the climate and biodiversity crises impact to the greatest extent.

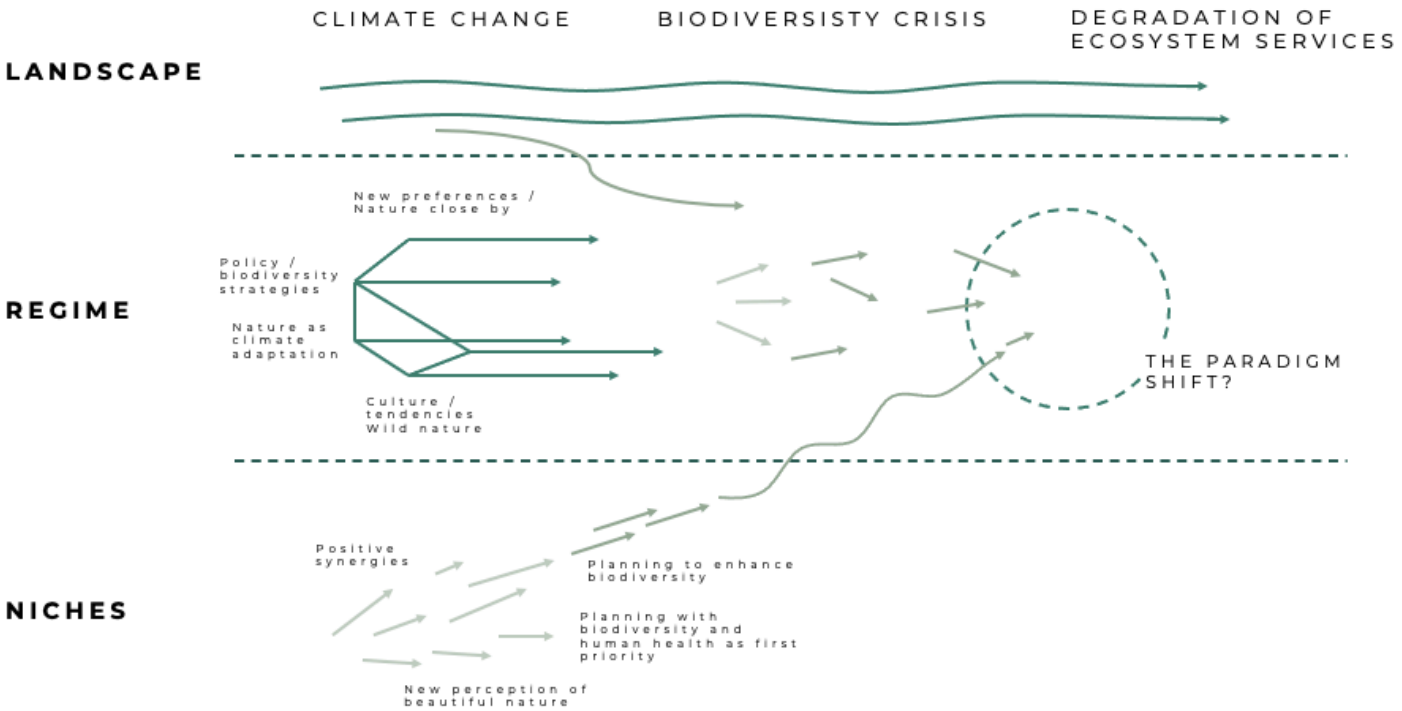


Figure 10 Our own MLP illustration.

5.1.3.2 MLP outline of Jernbanebyen

The climate challenges, the rapid loss of biodiversity and other elements of the landscape influence the regime, and new actions and practices become essential. Additionally, policy must support the change of the regime.

Regarding the case of Jernbanebyen, the development strategy of the area is affected by the numerous challenges outlined through the MLP figure, see Figure 10. The landscape as well as the regime and innovations are narrowed and adapted to the project.

We have narrowed the landscape to include direct drivers for change in an urban planning approach focusing on biodiversity including degradation of ecosystem services (see Figure 10). Although, biodiversity crisis and climate challenges are broad terms, the challenges integrated are related to biodiversity such as the rise of temperature, which affect species habitats.

The figure shows that the regime constitutes of policies and biodiversity strategies, which is applicable both on a global, regional and local level. Globally, the UN and the EU have taken initiatives towards achieving multidimensional sustainability objectives including targets to end the loss of biological diversity through among other things a biodiversity strategy (European Commission, n.d.-c) and the SDGs (United Nations, n.d.-b). However, to achieve the targets requires that economic and societal transformations in favor of biodiversity engaging all sectors.

On a regional level, the Danish government made a biodiversity strategy in 2014 (Regeringen, 2014), which has subsequently been revised, and on a local level some municipalities in Denmark have made their own strategy including Copenhagen (Københavns Kommune, n.d.).

Further, on a local level, tendencies in society affect the existing regime. In Copenhagen, there is a desire of more nature and biodiversity within the city (Københavns Kommune, 2022d), and a general rising knowledge of the biodiversity decline is causing new approaches towards nature. It is becoming more acknowledged to let nature grow wild for the benefits of biodiversity (Vincentz et al., 2019). This is shown in the figure with the middle arrows moving in different directions towards a paradigm shift.
Also illustrated by the figure is that nature is implemented through climate adaptation. Nature and biodiversity play an important role regarding regulation of the climate, and healthy ecosystems are more resilient to climate change (European Commission, n.d.-b). Nature within the city can positively affect the temperature and potentially mitigate the heat-island effect (Thuesen & Grunkin, 2022), and it can reduce the pressure on the sewerage system by delaying and minimizing the runoff - hence solve problems with e.g., stormwater (State of Green, 2022).

5.1.3.3 MLP and the current regime

An increasing focus on biodiversity globally, latest at the biodiversity conference (COP15) (UN environment programme, n.d.-b), has affected the practices and policies within the regime, opened for systematic changes and made it possible for niche-innovations to emerge. Innovations can create transition, which is necessary to "*entail profound changes in dominant institutions, practices, technologies, policies, lifestyles and thinking*" (Asquith, 1994). The innovations included in our MLP figure 10 relate to changing the planning approach in order to recover and improve biodiversity. But they are also to a great extent related to practices around and thinking of nature.

Innovations being insect hotels and synergies between nature and climate adaptation have strengthened the focus on developing cities with urban nature for the benefit of biodiversity. However, there is room for improvement, as there is still more planning than acting. The paradigm dominating the present regime and city development is still infrastructure and construction (Thuesen & Grunkin, 2022) and thus, a change of the existing regime must happen parallel with a shift in paradigm. Figure 10 shows that the disrupted regime will lead towards a new paradigm and establishment of a new stabilized configuration in the regime (Asquith, 1994).

Throughout this project, we aim to understand whether the desired visions for biodiversity at Jernbanebyen can be successful in practical terms for the developers in relation to the required change of the regime. Nature is acknowledged as important in cities (UN Habitat, 2022), but operation of nature to support biodiversity requires knowledge to succeed.
We use MLP to find the shortfalls in the regime for biodiversity to thrive in cities. It clarifies the perspectives of the various stakeholders and how the developers can be influenced to implement nature to a greater extent. It is used to understand the aspects of urban planning that must be affected to ensure that urban nature and improvement of biodiversity are included.
Within the cities, the environmental-related problems are apparent, but it is also here that the solutions can arise. Cities are

interconnected systems that offer a limitless number of potential solutions through systematic changes. The city developers must respond to changes in the climate and human needs as well as strengthen sustainable development with a focus on biodiversity.

Own picture, Jernbanebyen

5.2 Methodology

5.2.1 Applied research

The goal of applied research is to create workable solutions to challenges that exist in the real world. It entails applying already-developed concepts, methods, and expertise to tackle particular issues or challenges within a given field or industry (Rog et al., 1993).

> "*Applied research has its roots in the experimental method, but it uses scientific methodology to develop information aimed at clarifying or confronting an immediate societal problem. Its environment is often a messy one, with pressures for quick and conclusive answers, sometimes in very political context*" (Rog et al., 1993, p. 7).

It can be argued that the research question of this project is dealing with an immediate societal problem. All research within the topic of the biodiversity concerns aim to illuminate or find solutions to the enormous crisis. However, as argued in section 5.1.1 all research within the field of sustainability is deeply connected to working with wicked problems that to their core are not simple to solve. For this thesis working with a wicked problem with applied research has meant working towards a deep understanding of our case, the area's history as well as comprehending the current situation and its context with the many stakeholders, agendas, and future plans for the development of this part of the city - all complex and intertwined concerns.

Applied research is frequently carried out in collaboration with business or governmental partners that often but not always contribute funding and knowledge to the project. The development of new products, technologies, or processes are often the outcomes of applied research (Rog et al., 1993). For this thesis we as a research team has not gotten any funding from our partners however, DSB Ejendomsudvikling and the other stakeholders behind Jernbanebyen has been offering their knowledge and expertise on the topic.

Pragmatism and applied research complement each other perfectly because the core concept of both is to search for solutions to real world problems. They both offer a wide range of possibilities when it comes to choosing concepts, tools, and methods to support the research of the current investigation.

In the following paragraphs this project's chosen methods will be presented as well as how they have been applied. Furthermore, an overview of the informants involved in the project will be given.

5.2.2 Case study

We have used the method of case study to explore the case of Jernbanebyen in depth. The method has supported the understanding of the stakeholders' positions as well as how the current urban development planning paradigm has shaped the area.

A case study is founded on interaction in a real-world circumstance. A case is investigated because it contains complexity, incidents, or events that occurred over a specific time period and provide insight

into the structures, mechanism, and layers of the case (Olsen & Pedersen, 2015). It involves understanding participants or stakeholders with different positions, agendas, histories, and orientations (Olsen & Pedersen, 2015). In its essence a case study does not necessarily provide a solution to the examined problem. It seeks to explore and understand complex issues as well as to identify and define problems in the case. Normally, the research of a case study will not take any active part in the research however, because we as a research team are searching for functional, possible, and appliable recommendations we have become an active actor in the case of Jernbanebyen and are thus outside the traditional framework.

5.2.3 Semi structured interviews

The decision to conduct a qualitative interview, specifically a semi-structured one, is made in light of the opportunities that it presents through dialog for learning about a particular topic area (Brinkmann, 2014, p. 4). Semi-structured interviews provide the ability to collect detailed, qualitative data that can be compared (Brinkmann, 2014). In order to generate knowledge, it is essential to be able to compare the perspectives of the interviewees, as it can be used to understand the complexity of a paradigm shift in urban planning as well as to find the best possible solutions for Jernbanebyen.

In the following table an overview of this research interviewees can be found, and transcriptions of the interviews are in Appendix A.

Own picture, Jernbanebyen

Table 1 Overview of this research interviewees, and interview are in Appendix A.

Name	Title and company	Used for
Torben Gleesborg	Consultant, DSB Ejendomsudvikling A/S[1].	Understanding the landowner's role in the development and what their visions are for the area, especially regarding green elements and biodiversity.
Io Maria Schønherr	Project manager and architect, Cobe[2].	Getting insight of the visions in the master plan that they have co-created for Jernbanebyen and how they continue to work towards securing the green visions for biodiversity in the zoning law.
Mathilde Sakura Ballegaard	Landscape Architect MAA, Cobe.	
Morten Leicht Jeppesen	Urban horticulturalist, Metropolitan Metaculture[3] (MeMe).	Getting insight of their role in Team Cobe and understanding their approach in supporting biodiversity in urban development in general and in Jernbanebyen.
Julie Stjerneby Hvid	Urban developer and geographer, Metropolitan Metaculture (MeMe).	
Louise Overgaard Ploug	Special consultant in urban development, The Municipality of Copenhagen.	Understanding their role as the public administrator in the project and how they negotiate zoning laws and additionally to get an insight of their view on the topic of biodiversity.
Karin Thuesen Pedersen	Urban development director, COWI[4]. *Originally the initial contact to the network of developers of Jernbanebyen.*	Understanding their contribution throughout the duration of the project, and to understand the engineering part of urban development and how it has developed over time.
Tine Skafte Nielsen	Nature policy advisor, The Danish Society for Nature Conservation (DN)[5].	Getting a general idea of politics and development surrounding nature and biodiversity in Denmark, as an input to our analysis. Additionally, we aspired to get some advice to consider for our final recommendations.

1 Subsidiary company of DSB (Danske Statsbaner) and is intended to manage, develop, and transfer real estate on a commercial basis (DSB Ejendomme, n.d.).
2 Cobe is an architectural firm.
3 MeMe is consulting company that provides advise for implementation of solutions for planting, ecosystems, and biodiversity (Metropolitan Metaculture, n.d.).
4 COWI is an engineering and architecture consultancy.
5 DN is an NGO that focuses on creating more space for nature.

5.2.4 Literature study & document analysis

For this thesis, we have used narrative literature study. The method is defined by Bryman (2012) as a means to get an in-depth understanding of the body of knowledge in a particular field. Bryman claims that one's research questions and problem formulation should serve as the basis for any choices regarding literature searches. Critical reading is important, as it recognizes dominant theories and unmet gaps in the study field (Bryman, 2012).

Moreover, our research has been strongly affected by document analysis (Asdal & Reinertsen, 2021) and the reading and examination of numerous documents, mostly from COBE and Jernbanebyen. Since documents make it easy to quickly gather a lot of information, using them as qualitative data is time and resource efficient. Documents are 'unaffected', meaning that the documents and subject field are not affected by any additional empirical data collection. Visual items, regulations, PowerPoints, statistical data, and text in a single or numerous sentences are all examples of different types of documents (Asdal & Reinertsen, 2021). Documents serve as 'mediums' and as reflections of reality. As a result, it is crucial to take all sources intentions or agendas into account.

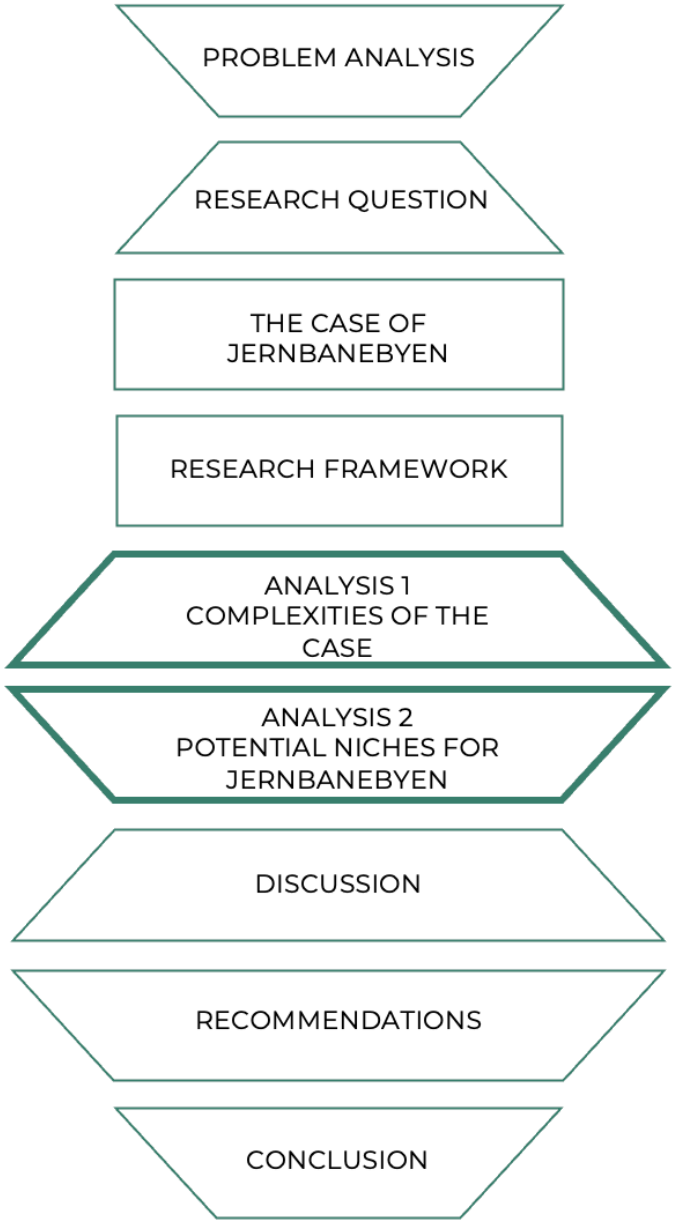
5.2.5 Condensation of meaning

In the analysis there has been made use of the method *'Condensation of meaning'*. To do this, an interview must be methodically handled in steps, such as reading it through, finding units of meaning, and thematizing those units in accordance with the researcher's understanding of them. Further, it also concerns how the information from the interview should be divided into smaller segments that connect to what the interviewee has stated about a specific issue. This can be done by asking questions about the units of meaning in relation to the interview's purpose (Kvale, 2015, p. 269). Moreover, all the collected empirical data has been performed in Danish meaning that quotes used in this report all have been translated.

6 READING GUIDE FOR THE TWO-PART ANALYSIS

The problem analysis (section 2) has outlined the overall landscape of the multi-level perspective and the critical biodiversity crisis. In the problem analysis we emphasize that land use is the biggest threat to natural habitats and that the decline in biodiversity makes it a crucial element of urban planning. Further, planners must understand what different kind of *nature* that contributes to biodiversity for instance tiny pocket parks, which are species-rich in the composition (Rasmus Vincentz et al., 2013).

This makes us question whether there is a possibility for a paradigm shift within urban planning of brownfields with biodiversity as a focal point. Likewise, how this potential paradigm shift can happen. Throughout our research, the case of Jernbanebyen has been central and most knowledge is gained through empirical data collection including contributions from the stakeholders (presented in Table 1 of stakeholders) of Jernbanebyen. We have had a pragmatic approach to our research and the intention of our semi-structured interviews has been to collect information to compare the stakeholders' positions, perspectives, and agendas for the analysis.



The analysis is conducted within the framework of MLP and position the case of Jernbanebyen within the regime. The overall regime is illustrated in section 5.1.3.2, but in the following we have zoomed in on our case, which is one element of the broader regime. This is done as we aim to examine biodiversity initiatives through the case to comprehend whether the case can indicate general initiatives for biodiversity at brownfields within the regime and exists as a lighthouse.

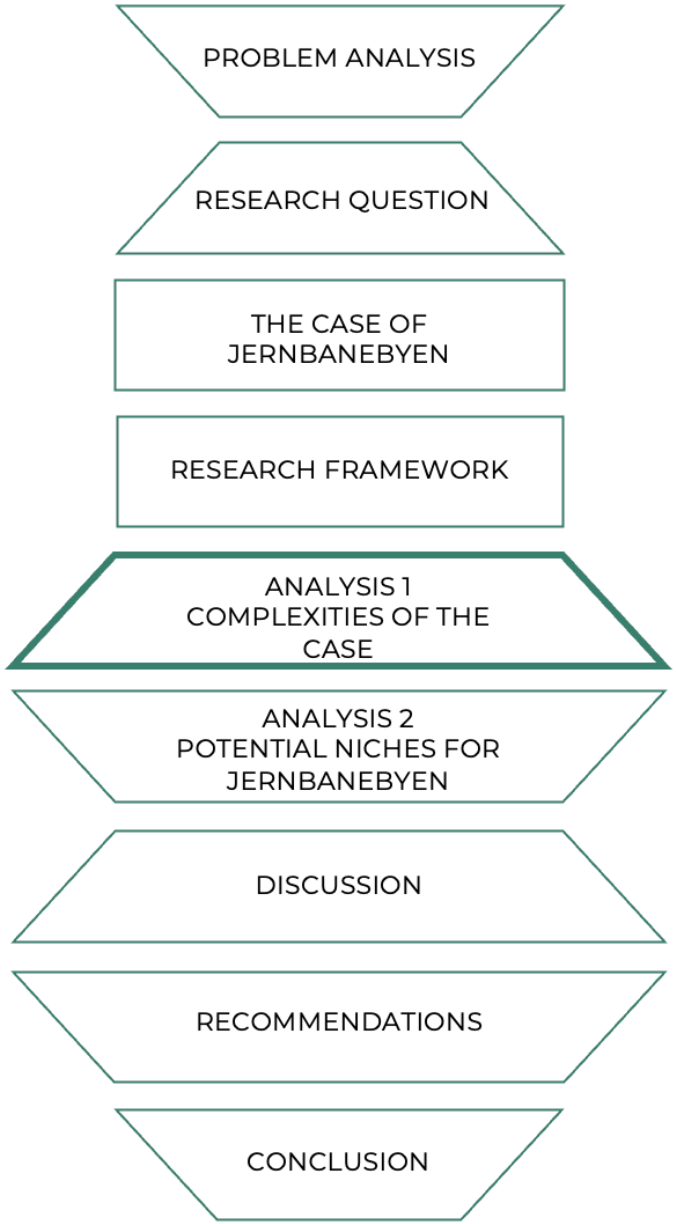
Additionally, we look into which transitions that are spiring outside the regime - the niche innovations. In order to do this, we will through the analysis unfold our discovery of niche innovations within biodiversity solutions in urban development based on the knowledge collected from the empirical data and our desk research.

The niches presented are not necessarily unknown in the biodiversity field however, we argue that they are yet to become part of the established regime. We see a potential in the presented niches, because they have been successful in other projects in the field and thus, it can be argued that the niches are 'easy' solutions. Nevertheless, that is exactly what we seek, as one of the goals for this thesis and part of our research agenda is to find and analyze possible solutions that can be implemented at Jernbanebyen. We seek to find common ground for the stakeholders and initiatives, which they can collaborate on and co-create. Hence, the analysis and the observed perspectives of the different stakeholders' perspectives in relation to biodiversity are colored by our agenda.

Own picture, Ørestad

7 ANALYSIS 1 - COMPLEXITIES OF THE CASE

The first part of the analysis will examine the stakeholders of Jernbanebyen's perspectives of biodiversity in urban planning to be able to evaluate the potential of implementing the niche innovations analyzed in the second part. The analysis will help us to understand the complexity of the development of Jernbanebyen regarding biodiversity and what opportunities the various stakeholders have to support biodiversity. This applies both during planning as well as the execution and subsequent operation of the area. In addition, we seek to understand the stakeholders' green visions and how these are positioned in relation to trend and tendencies that occur in the existing planning regime, which Jernbanebyen is positioned within.



7.1 Planning of the zoning law

As mentioned in section 7.1, it is the Municipality of Copenhagen's role to establish an approved zoning law for the area of Jernbanebyen. The essence of this task is to make a framework-change for the area, due to a portion of the land being converted from technical facilities to a mixed residential and business sector (Københavns Kommune, 2019, p. 87).
This task, forming a detailed plan with legally binding provisions, entails many different perspectives to be addressed and negotiated e.g., subjects within infrastructure, choice of materials, aesthetics, and open spaces among others (Erhvervsministeriet & Miljøministeriet, 2009, p. 112). The municipality's authority in setting the conditions is covered by the national Planning Act, which forms the basis for the public authorities' management of future land use, the hierarchy of the Planning Act is shown in Figure 11 (Post & Dansk Byplanlaboratorium, 2018, p. 6).

It is crucial to specify that as the focus of our research has been exclusively on biodiversity, we primarily concentrate on one of the numerous issues that the stakeholders involved in the development of Jernbanebyen are currently negotiating.
Having acknowledged that through an interview with Julie from Metropolitan Metaculture (MeMe), we learned that the national Planning Act yet has to determine a framework for requirements specifically for biodiversity (Hvid, 2023, p. 2). There is only one mentioning of biodiversity in the national Planning Act, which is within the purposes of the law; "*The law particularly aims to support biodiversity…*" (Erhvervsstyrelsen, 2022). It is thus limited

Figure 11 Simplified visualization of the hierarchy for the planning act down to the planning of zoning laws. Own figure with information from (Post & Dansk Byplanlaboratorium, 2018).

what the municipality can instruct and require for biodiversity through zoning laws.
We also found this said between the lines throughout our conducted interviews. Louise from the Municipality of Copenhagen clarified the whole dynamic in the planning of the zoning law, where the developer wants a greater span of freedom to adjust through the advancement of Jernbanebyen, while they on the other hand as the public administrator have an interest in advance to assure certain qualities for the district:

> "*As a developer, you obviously need a bit more space, in relation to the fact that you don't know exactly what is going to happen, and we as a municipality would like to ensure certain things. So that's the balance we have to find*" (Ploug, 2023, p. 7).

This perception matched Torben Gleesborg's, the representative from DSB Ejendomsudvikling, statement concerning the negotiation process that most disagreements that must be handled are probably with the municipality - not discussions of the purpose of the zoning law, but what level of detail should be included:

> "*If there is anyone we disagree with, it is of course the municipality. And it's not like I think we disagree about what the aim of the zoning law is. But our concern is perhaps more about the fact that we think that the municipality too often wants to go too far in deciding something. Where we think 'why the hell do you want to decide that?' Because it does not have any significant influence on the city we are building. And I agree that the municipality has a lot of bad experiences from previous local railways, so of course they gather experience. Just like the rest of us do, from building to thinking that next time I will do it in a different way. But I think that where we mainly disagree with the municipality is simply something like this, what is the level of detail for the area*" (Gleesborg, 2023, p. 15).

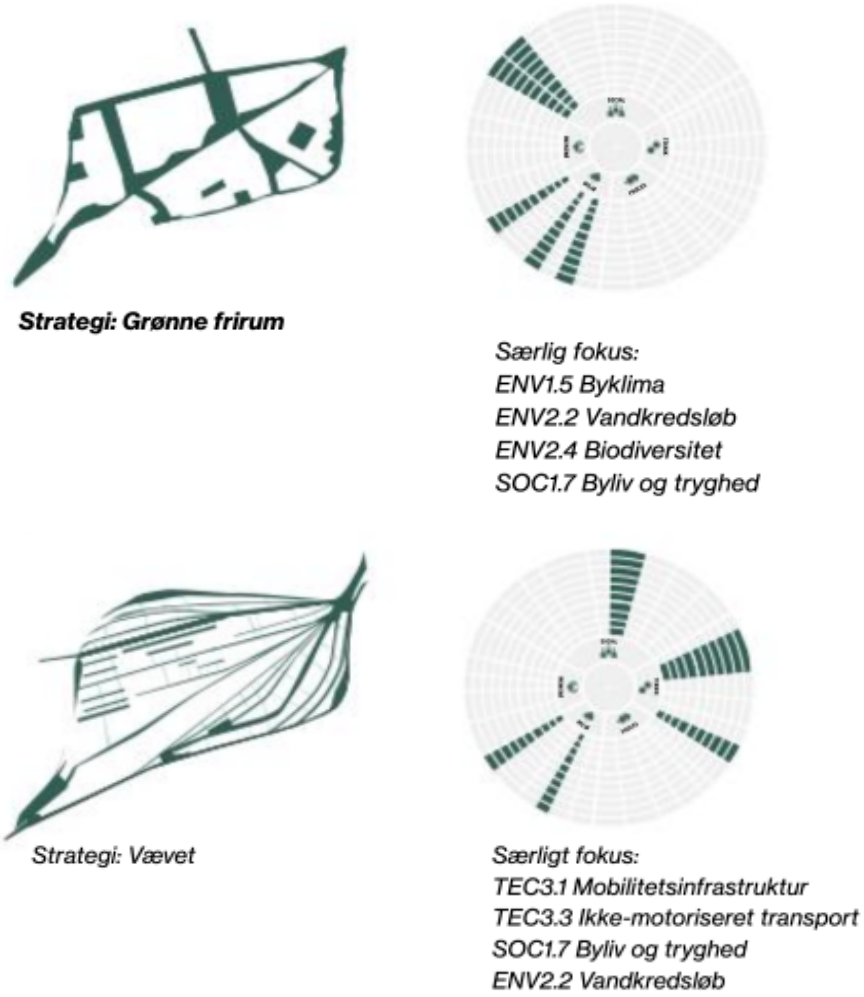
Torben also emphasized that the municipality did not, as for now, have the authority to pinpoint incorporation of biodiversity in the zoning law, but he believe that the municipality should rather encourage through concrete actions, like how to treat soil to keep it favorable for a healthy ecosystem (Gleesborg, 2023, p. 7).

In negotiating the zoning law, which will be legally binding, and which provisions must be complied with, the landowners are careful not to include some specifications in the plan that possibly could be a hurdle in the future (Gleesborg, 2023, p. 14). Considering how the municipality of Copenhagen aims to make Jernbanebyen the good example for future development with focus on the green spaces (Københavns Kommune, 2019), the dialogue around the zoning law and linking it to biodiversity show that they do not have the authority to make that decision yet.
Louise from the municipality added in her interview that for the time being, developments emphasizing biodiversity require trust in

the developers' interest and commitment to prioritize it (Ploug, 2023, p. 3).

7.2 The 'green' vision

A vision for Jernbanebyen was created early on by DSB Ejendomsudvikling and Freja Ejendomme with the help of several subject experts in a vision follow-up group and in close collaboration with a number of local stakeholders (Schønherr & Ballegaard, 2023). Later, the vision was made concrete in connection with the execution of the architectural competition that Team Cobe won. As stated in the case description (section 4), one of the main focuses of DSB Ejendomsudvikling and Freja Ejendomme's initial concepts for the area was their 'green' ambitions for the site, where green implicitly meant sustainable. Sustainability is deeply integrated in many different layers of Cobe's plan, with the help from DGNB as a sustainable process and planning tool (Cobe et al., 2021, p. 14,15). Furthermore, the focus on the environmental aspect and concretely biodiversity was highlighted in Team Cobe's project as a special focus in the chapters: '1. Grønne frirum' (Cobe et al., 2021, p. 16) and under '2. Vævet' (Cobe et al., 2021, p. 24), and these two strategies are shown in Picture 4.



Picture 4 Two of Team Cobe's green connection strategies. (Cobe et al., 2021, p. 16+24)

According to Torben Gleesborg there is a big demand for rethinking how we plan our cities, and he explains how it is *natural* that biodiversity is incorporated into the approach for Jernbanebyen (Gleesborg, 2023, p. 6). He further argues that there is a need to create more space for animals and plants, and that it is neither necessary nor makes sense to create lawn after lawn with short cut grass where no animal can survive (Gleesborg, 2023, p. 6,7). However, there is a need to have a balance in the overall strategy regarding nature:

> "*So, it is simply that with the strategy we have laid out for the urban area, it is only natural that we must have*

biodiversity. And without it becoming something like, I should perhaps say, fanatical biodiversity for biodiversity's sake" (Gleesborg, 2023 p. 7).

Furthermore, Torben argues that letting the lawns 'grow wild' will not make the city look ugly or messy but on the contrary more pleasant to be in. When we inquired Torben about the wording *natural* he explained that it is closely linked to the feeling of responsibility and thus, they (DSB Ejendomsudvikling) are not branding themselves on being frontrunners or developing cutting edge solutions, they just want to create a part of the city where humans and nature can coexist (Gleesborg, 2023).

He explains how part of it is due to the trends in society but argues that it is also just common sense (Gleesborg, 2023). While the municipality, neighborhood organizations, and the development team all claim to have good intentions for the area, not everyone is as enthusiastic about this new neighborhood's mix of residences, businesses, recreational areas, and green spaces. In an 'idea catalog' for Jernbanebyen following statement from a citizen can be found:

> "I *would like to propose that Jernbanebyen becomes a large park with no housing at all, except perhaps for the 184-youth housing, which is already under construction. We badly need a green breathing hole in the district, which is already densely built-up from Hovedbanegården to Sluseholmen. The old locomotive workshops must be preserved, even if they are only worthy of preservation and not listed. Consider extending Fælledparken with housing?*
>
> *I hardly think you would*" - Ole Lindegaard (Freja Ejendomme & DSB Ejendomsudvikling, 2020, p. 31).

Despite the criticism, the intentions of developing Jernbanebyen through a new approach enhancing biodiversity show that the stakeholders involved are aware of the biological degradation. However, the stakeholders and the municipality face barriers due to a lack of authorization and requirements that accommodate biodiversity. The stakeholders though aim to implement

Picture 5 Illustrated proposal of the site from architect Peter Kjær and biologist Jesper Møller. Visualized by Mads Berg. Showcasing even stronger wishes for nature, biodiversity and green spaces (Freja Ejendomme & DSB Ejendomsudvikling, 2020).

biodiversity to a possible degree by among other things using DGNB certification as a guideline.
Additionally, the stakeholders' statements regarding the demand of rethinking city planning and to make it natural to implement space for nature to promote biodiversity indicate the tendencies of our societies.

7.2.1 Trends and tendencies

As mentioned in above paragraph Torben expresses how societal trends and tendencies have influenced how the landowners' vision about a 'green' city has come to be. We dove into the aspect of how trends and societal tendencies influence how we plan and develop our cities in our interview with Karin Thuesen Pedersen from COWI. Karin argues that the project of Jernbanebyen is a response to what is going on in our society right now (Pedersen, 2023, p. 7). She explains how during the Covid-19 pandemic people became aware of what types of nearby areas they were surrounded by and quickly could visit (Pedersen, 2023, p. 7,9):

> "*And you can say exactly this, that we experienced during Covid-19 that if you lived in a city, it was actually a long way to get out to some nice places. And it's a bit funny too, because if you look at it also historically, there are also some very clear trends in the way Copenhagen has developed. Some of the very big moves that have been made over time are the result of certain things affecting us*" (Pedersen, 2023, p. 9).

Karin further elaborates telling how people often want nature and green spaces around them, but that it is known that it has to be very close otherwise people will not use it: "*In other words, there shouldn't be many hundreds of meters, otherwise you won't get there*" (Pedersen, 2023, p. 9). According to Io and Mathilde from Cobe, when the team had to create the vision for Jernbanebyen, it was also about taking 'the pulse' of the city and understanding what Copenhagen needs right now (Schønherr & Ballegaard, 2023, p. 3).

Moreover, according to Io and Mathilde, when discussing how trends and tendencies influence the development of our cities, it is also about looking at what part of the city that is going to be developed. They further explained how their development with different harbor fronts in Copenhagen often meant for people to have access to 'the blue city', easy access to the water and for residence to be able to see the canals from their windows (Schønherr & Ballegaard, 2023, p. 3) . Whereas in Jernbanebyen the focus is on 'the green city', close and accessible to a different type of nature, and where nature gets prioritized differently:

> "*So now we have something that separates the plan to make a bigger hierarchy, but how do you get the green close to where the people are*" (Schønherr & Ballegaard, 2023, p. 3).

7.2.2 The vision

In our second interview with Cobe, Mathilde and Io explained how the coherent green urban space, which creates new opportunities for biodiversity, has been anchored in their strategic direction in such a profound way that it cannot simply be plucked out, as then what is left is a completely different plan for the area (Schønherr & Ballegaard, 2023, p. 3).

As explained in the above section, one of the reasons for this is how Cobe experienced a sudden profound need, almost a demand, for more green spaces in Copenhagen. It therefore became obvious for the team to incorporate fundamental ideas for establishing more green spaces and urban nature in their plans from the beginning (Schønherr & Ballegaard, 2023, p. 3,4). Some of this need was experienced from the citizens, but the extra vigilance on biodiversity came from the municipality with the development of their biodiversity strategy, which also played a huge role (Schønherr & Ballegaard, 2023, p. 4).

Furthermore, the *Municipal Plan 2019* also had an impact as Io describes: "*because there was a requirement that there must be 9-12 hectares of green, and two hectares contiguous. And it is very, insanely difficult to achieve with these building percentages and still be able to accommodate it*" (Schønherr & Ballegaard, 2023, p. 4).

Own picture, Jernbanebyen

According to Tine from Danmarks Naturfredningsforening (DN), it is moreover key to acknowledge that biodiversity has become a shared commitment for the Municipality of Copenhagen and is rooted both at the citizen representation and the Lord Mayor. This is important to ensure that it is no longer just geekery for the Mayor of Technology and the Environment, and to ensure that action plans and evaluations are carried out (Nielsen, 2023, p. 7).
Io and Mathilde additional elaborates in their interview that of course minor changes can and will happen to the strategy, but biodiversity is anchored into their plans and is not possible to eliminate (Schønherr & Ballegaard, 2023, p. 4).

This anchor has been co-created by MeMe who is a partner in Team Cobe's project and has developed the biodiversity strategy for the project. In our first interview with them, MeMe explained how they have a holistic approach to sustainability and to biodiversity (Jeppesen & Hvid, 2023, p. 2). Further elaborating on how this project is heavily focused on carrying out the proper actions from the beginning, Morten Jeppesen from MeMe expressed:

> "*With the increase of focus on biodiversity, from an international and regulative point of view, there is a great trend in urban planning with trying out methods to integrate biodiversity successfully in urban development*" (Jeppesen & Hvid, 2023, p. 3).

For MeMe the project of Jernbanebyen has meant to understand the biodiversity of the special area being a railway habitat, and to understand soil quality and how important it is to ensure the survival of the already existing habitat structures on the site (Jeppesen & Hvid, 2023, p. 3). This has been necessary to have a solid foundation to build their solutions and recommendations on. Besides the classical biological and geographical examination of the area e.g., counting of trees and soil testing, MeMe also put a lot of weight to understand both the cultural and natural history of the site (Jeppesen & Hvid, 2023, p. 5).

7.2.3 Natural & cultural history

To elaborate on the above, an example of this can be found when Morten from MeMe explained the importance of telling the many exiting 'nature-stories' of the site. For instance, the owlet moth; toadflax brocade (Latin: Calophasia lunula) was found at the site.

Picture 6 Owlet moth (Graham Calow Sapcote & NatureSpot, 2022).

This endangered moth is generally only found exclusively in Skagen and Gedser in Denmark. By repeatedly telling the stakeholder group the story of how this moth is directly linked to the plant Linaria and how the cultural history of the site is deeply connected to the survival of very special flora and fauna have "*helped move some things forward*" (Jeppesen & Hvid, 2023, p. 5). It is a story about how the site's train operation has directly impacted the biodiversity, and how it is not only about the area's natural history, but a deeply rooted link to the site's identity and thereby deserves to be persevered and nurtured going forward (Jeppesen & Hvid, 2023 p.

5). Morten and Julie from MeMe deeply care about telling the true story of the site, this can be seen in the following quote summoning up above points:

> "*That is, it is not just a piece of natural history, it comes as a consequence of the culture and societal dynamics of the place. And therefore, it is worth cultivating because it is part of the real identity of the place*" (Jeppesen & Hvid, 2023, p. 5).

And precisely preservation value is a perspective that Cobe backs up. They find it as a rare opportunity to be part of the development of an area in the city, where it is possible to find over 100 years old trees and thus, Cobe wish to "*raise it up to be a huge asset that you have as a city*" (Schønherr & Ballegaard, 2023, p. 3). Io further expresses: "*we see nature as much as the buildings, as being an element worthy of preservation in the plan*" (Schønherr & Ballegaard, 2023, p. 3).
Understanding the area's current preservation status is of extremely importance. Connecting the spirit of the area (Genious loci) with what is already surviving and thriving at the site should be the indicator for the final landscaping, the complete plant "expression" and overall species combination (Jeppesen & Hvid, 2023, p. 12).

Own picture, Jernbanebyen

7.2.4 Balancing species

According to Karin from COWI species combination is all about symbioses and symbiosis-effects (Pedersen, 2023, p. 12). Furthermore, it is important to recognize that some of the species that have ''arrived'' by train at the site do not fit into the stakeholders' overall biodiversity strategy for the area meaning that not all species can be embraced equally. MeMe elaborates explaining that the dominating trait for the area is based on the counting of species and establishing the 'species in focus', which has become the foundation for the rest of the strategy (Jeppesen & Hvid, 2023, p. 13).
This direction is supported by Tine from DN who stated that it is essential to incorporate some species at the site who can spread out in the area (Nielsen, 2023, p. 3), and some species indeed thrive in the habitats the city can offer (Nielsen, 2023, p. 10). She elaborates: "*And then I think that for health and well-being, quality of life and this learning to follow nature, it is of immeasurably great importance*" (Nielsen, 2023, p. 10).

Io and Mathilde from Cobe explain how it is not possible to declare regulations for biodiversity in their collaboration with the municipality regarding the zoning law for the area. The wide wiggle room in this area thus means that Cobe can describe a lot of good intentions for the site especially regarding trees but also more generally for species and habitat (Schønherr & Ballegaard, 2023, p. 9). But despite this, the building plots are chosen without consideration for biodiversity.
According to Io and Mathilde, regulations for biodiversity in the zoning law could be beneficial however, the absence of strict regulations for biodiversity is not necessarily a bad thing. For instance, if certain tree species are listed in the zoning law but time reveals that some of these specific tree species have root issues, a regulation can further complicate the matter (Schønherr & Ballegaard, 2023, p. 9). They further elaborate that the many different types of scenarios are the reason that they are accepting more general rules of thumbs (Schønherr & Ballegaard, 2023 p. 9).

On our walk of the area with Julie from MeMe, she explained how their biodiversity strategy is tied up to DGNB certification and how the wished certification of the area has helped them with their agenda especially in accordance with the preservation of specific trees or parts of the area (Hvid, 2023, p. 3). Julie also expressed similar concerns about undesirable scenarios that Io and Mathilde did. Additionally, Julie elaborated on the complication between existing species of the area, invasive species, and how it is immensely complicated to find the best balance in how to handle so many possible scenarios:

> "*The fast-growing quality is not in itself a problem, it's a great quality in an ecosystem where cattle, sheep, oxen etc. graze, because it can quickly grow back and cover the soil – but if it goes unmanaged, it can outcompete other species and the (plant) community becomes less diverse and poor on species*" (Hvid, 2023, p. 8).

Team Cobe and the other stakeholders are challenged in relation to create the best combination of habitats in order to balance the site's variation of species. However, the understanding of

Jernbanebyen's species and the lack of strict requirements together create the foundation for biodiversity, which gives Cobe a possibility of having good intentions for the site's future species and habitats structures. In addition, the stakeholders must also create a structure where nature and human activities can coexist, which require a balanced decision-making with a necessary regard for nature and citizens involvement when developing an appealing city. This is further emphasized in the following section.

Own picture, Jernbanebyen

7.3 Coexistence between human and nature

According to Torben, the stakeholders wish to have designated spots at Jernbanebyen that are assembly points for the life of the whole area. The big public park and the two city squares; one at *Værkstedcentralen* and one at *Tøjkammerbygningen*, will be the focal points where shops, cafés and life are supposed to happen (Gleesborg, 2023, p. 12). Furthermore, he explains how important it is to also create private spheres, where people can have more peace and quiet, and which feels a bit more like their own private garden:

> "*That they can sort of find a place where it's natural and also sort of provides a kind of privacy for you to have your birthday party without someone suddenly coming with a ghetto blaster or sound box and then ruining the whole party*" (Gleesborg, 2023, p. 13).

What is needed to create the ''good city life'' has also been a topic for Team Cobe, and Io and Mathilde described their efforts to engage in dialogue with numerous actors by bringing in various types of experts e.g., a specialist in feminist city planning (Schønherr & Ballegaard, 2023, p. 6). A concern for them is to ensure good communities, where they have considered the many different types of people who wish to live there from seniors to students, to big families (Ballegaard, 2023, p. 6). Io and Mathilde further elaborate that it is all about a balance in deciding what is realistic and understanding human behavior, everyday practices and that different life phases equal different needs for the space we live in (Ballegaard, 2023, p. 6). Ensuring a broad palette of an attractive city is an iterative process (Ballegaard, 2023, p. 7). Mathilde and Io explain how they try to combine their dialogues with expert and citizens with the newest research, but unfortunately, they do not have a lot of statistic to tie these things together with. However, they express that zones for different activities is a big anchor in their overall strategy (Schønherr & Ballegaard, 2023, p. 7).

When discussing how to get human needs and nature to coexist in the area, Tine from DN claims that: "*you can say the challenge is always the collaboration with the Municipality of Copenhagen to set aside some proper green space for the free and recreational space for the citizens, but also so that there can be some nature and biodiversity*" (Nielsen, 2023, p. 3). She further argues that this part of the city in general is characterized by density and might be in desperate need of a '*green sanctuary*' (Nielsen, 2023 p. 3).

The possibility of rethinking how to create more space for green areas is taken into account with the plan of Jernbanebyen to become 'a car free' district with a system of one-way streets, a special bus lock and designated parking garages. It will be possible for delivery cars, postmen, the fire department and such to move around, but the streets are designed to be narrow to give room for more recreational areas. According to Io and Mathilde: "*it will*

certainly place some demands on those who choose to have their culture here, work here, or live here, that is, you buy into this vision and this lifestyle" (Schønherr & Ballegaard, 2023, p. 12).

Team Cobe involved the citizens when developing their competition material (Schønherr & Ballegaard, 2023, p. 4) and states that there is a high focus on this involvement (Schønherr & Ballegaard, 2023, p. 6). This includes Vesterbro and Kongens Enghave's local committees, a neighboring football club, Banegården and other existing tenants (Schønherr & Ballegaard, 2023, p. 4) that hopefully will stay in Jernbanebyen (Gleesborg, 2023, p. 4).

Generally, citizens involvement occurs in the planning of the zoning law process through public hearing and, in the case of larger projects, a citizens' meeting. However, in the case of Jernbanebyen, funds have been set aside for an extended citizens hearing (Ploug, 2023, p. 9), and time has been invested in city walks and workshops for citizen to engage in the project and accept it (Schønherr & Ballegaard, 2023, p. 6). Some of the wishes from local citizens have among other things been soccer fields and a desired cultural center (Schønherr & Ballegaard, 2023, p. 5), (Hvid, 2023, p. 3,4) as well as big green parks (Hvid, 2023, p. 1). However, it can be argued that it is contradictory that while the public demands green spaces, it is the citizens representation that has contributed to the decision that decades-old biodiversity must be destroyed to make way for a future garage (Hvid, 2023, p. 1). So, despite, the citizens' desire to be surrounded by more natural areas, they still make more choices that do not help to strengthen the coexistence between human and nature when it comes to perspectives of everyday life.

Own picture, Vesterbro

7.4 Day-to-day operation

Buying into the vision about a green part of the city where nature and biodiversity thrives will further place a demand on the citizens. Through our project we have in our dialogues with the stakeholders focused on citizen involvement and how zealots, stakeholders, residents, and others are essential to include to support biodiversity, given as the zoning law does not take this into account. According to Louise Plough from the municipality true citizen involvement is needed; Jernbanebyen is going to constitute a great area in Copenhagen and hence, involvement of citizens in the surrounding area is imperative (Ploug, 2023, p. 9). The rigid structures must be eliminated under the new paradigm, and zealots must be given greater responsibility. Citizens are used to the fact that the maintenance of public areas is often outsourced and that they have little influence regarding it.
Given how the public uses the spaces, the residents do not feel like they own them and therefore, in order to facilitate operations, it is crucial to include more citizens than just a few zealots among the locals (Hvid, 2023, p. 9). However, when citizens become involved in urban planning, they are engaged during the early stages of the process but, as daily operation begins, they are preoccupied with other activities (Nielsen, 2023, p. 9,10). To retain citizens' involvement, Tine from DN argues that the operation of nature must be facilitated for them (Nielsen, 2023, p. 9,10).

When we discussed the long-term preservation of flora and fauna, Torben from DSB Ejendomsudvikling did not bring up the citizens, instead he focused on qualified experts overseeing the green spaces (Gleesborg, 2023, p. 10). Torben expresses his wonder on why the municipality and landowners in Copenhagen, in general, tend to invest so much money in the initial creation of the green areas but give little attention to its ongoing, long-term maintenance. In our interview he further stated:

> "*And if you ask a specialist in the green field, they will say that the establishment period for these plants here is quite important. So, for the first 3-5 years you have to be over your plants more than you are for the rest of your operating period, because they have to gain their volume, they have to grow, they have to find their place in the environment they now are put in. And I wish that we at Jernbanebyen were able to follow that mantra and say that we spend extra resources for the first time to get things growing and close*" (Gleesborg, 2023, p. 10).

Due to experience Morten from MeMe wishes that they could be some type of biodiversity mentor for the day-to-day operation of the site when everything is established and developed (Jeppesen & Hvid, 2023, p. 14). Morten calls it '*nature-based operation supervision'* and elaborates explaining that it is based around a completely different understanding of nature and what concrete measures it needs to thrive. He concludes this topic saying that since they were lucky enough to be part of the winning team, they are still involved in the development and asked for advice, which they will give until '*they are kicked out'* (Jeppesen & Hvid, 2023, p. 14).

Overall, this section settles that there needs to be a focus on how the daily operation of the nature, biodiversity and green areas in Jernbanebyen should be operated in order to ensure preservation after the initial creation; expert knowledge combined with partnerships and citizen involvement could possibly be a successful recipe.

Own picture, Jernbanebyen

7.5 Sub conclusion first analysis

In the problem analysis we investigated the current landscape our case of Jernbanebyen is positioned within, and in this first part of our analysis we have explored the stakeholders' perspectives within the regime. The first analysis emphasizes that the Municipality of Copenhagen through the zoning law do not have authority to set requirements for biodiversity. The municipality, the zoning law and the national Planning Act represent the existing regime and how it is not established in favor of biodiversity. Despite this, in the development of Jernbanebyen the municipality does have an aligned agenda with the landowners to protect and support biodiversity however, there are no guidelines, rather complexities in the legal requirements in the zoning law.
Torben describes how DSB Ejendomsudvikling desire more dialogue to avoid obstacles that hinder the spread of biodiversity. He continues by explaining that they require assistance to carry out the extra measures for biodiversity. Hence, Torben rather sees that the municipality support these measures instead of writing a biodiversity strategy, which is not supported in the zoning law.

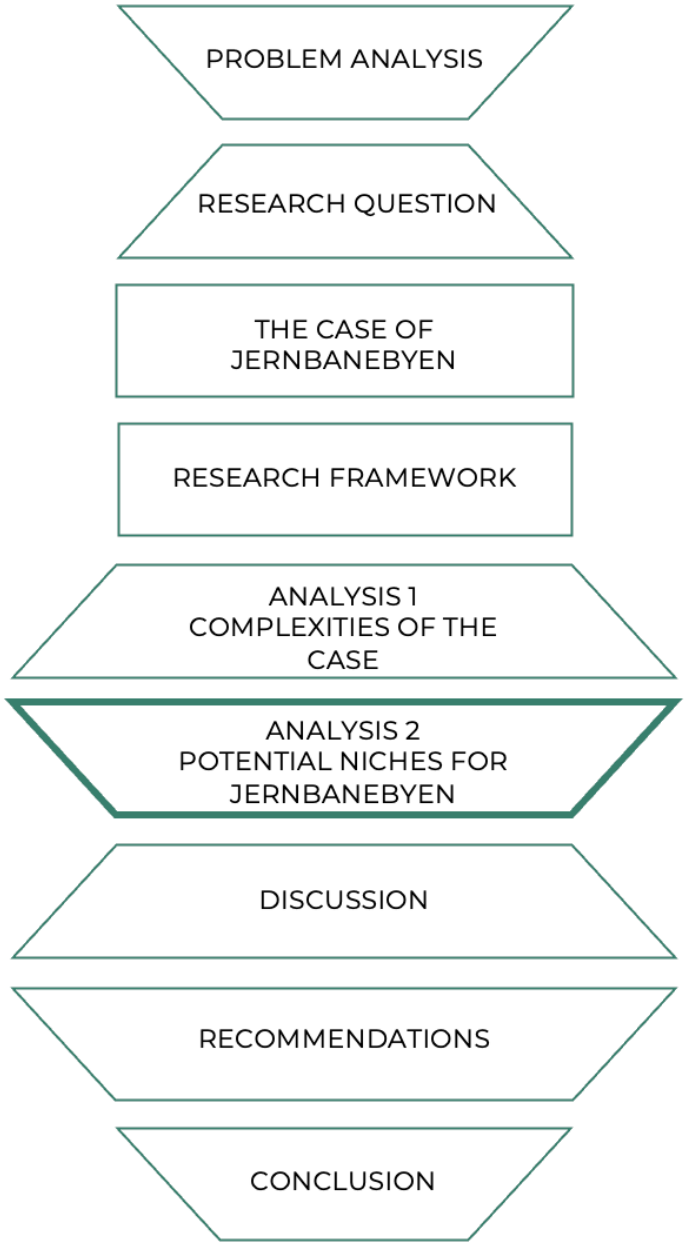
Societal trends and tendencies are of great importance in how cities develop over time. Karin from COWI points out that people need nature and green spaces to be close to them in order to use them, and she argues that the project of Jernbanebyen is a clear response to the societal tendency of citizens missing green spaces in the city. Similarly, Io and Mathilde explain that the City of Copenhagen for many years have been developing big urban areas along the canals of Copenhagen, establishing 'the blue city', and now, with Jernbanebyen, there is a focus on creating 'the green city' (Schønherr & Ballegaard, 2023, p. 3).
Furthermore, according to Torben, city planning needs to be reconsidered, and landowners' accommodating in meeting that need is tied to include biodiversity.
In Team Cobe's master plan, the biodiversity aspect is specifically incorporated as an anchor in the open green spaces and as a part of a green weave throughout the area (Schønherr & Ballegaard, 2023, p. 4). MeMe expressed that to integrate measures for biodiversity in the development of Jernbanebyen, it has been important to understand the area's current environment and ecosystems, and then set a plan to protect and support it (Hvid, 2023, p. 3). Jernbanebyen is characterized by its track fauna and telling the many existing 'nature-stories' could be argued to be important to the site's future biodiversity.

Since the stakeholders are currently developing the zoning law and have not yet started construction in the area, we see a chance to influence the stakeholders' decisions regarding biodiversity by comprehending their perspectives and positions. In addition, the absence of biodiversity-related requirements provides an opportunity to embrace niche innovations.
The utilization of niche innovations constituting different biodiversity initiatives, which can be carried out in accordance with the stakeholders' current abilities, will be examined in the second analysis as well as the potential for engaging in partnerships in the development of biodiversity at Jernbanebyen.

8 ANALYSIS 2 - POTENTIAL NICHES FOR JERNBANEBYEN

In order to support the development process of Jernbanebyen regarding biodiversity, the landowners have already partnered with stakeholders who represent innovative niches with biodiversity as the focal point, such as MeMe. We aim to emphasize this initiative and its potential through this analysis. Our focus is to support biodiversity as best as possible in Jernbanebyen and thus, our purpose is to analyze measures that should be implemented to enhance biodiversity. The measures included is based on the stakeholders' statements from the first analysis and from this an evaluation of their options carried out by us.

Each niche implemented in the analysis will be explained and analyzed in relation to realize it at Jernbanebyen. The niches analyzed are already implemented in urban development projects and are thus not radical changing innovations. However, we investigate how they are already used and how they can be used in Jernbanebyen to preserve and enhance biodiversity. Furthermore, we can already see the first signs of some of the measures at site, so the purpose of the analysis is to assist in enhancing the stakeholders' contribution to biodiversity. Despite the connections between the niches, the sections can be read independently of one another.



8.1 A green network through and to Jernbanebyen

Ecosystems and biodiversity know no administerial boundaries (Rahbek & Manghezi, 2023, p. 12) and consequently, there is a need for implementing these matters into urban development, which entails creating a coherent weave throughout the site of Jernbanebyen. Establishing cross-cutting, continuous green elements and bridges is essential to create more beneficial conditions for biodiversity, as one 'postage stamp' in the city cannot maintain a viable population and sustain nature in itself (Rahbek & Manghezi, 2023).

A green network is part of the master plan for Jernbanebyen and one of the strategies that Team Cobe has made in order to make Jernbanebyen a green district (COBE, n.d.). Cobe is very keen on including it as part of the final zoning law (Schønherr & Ballegaard, 2023) however, links to larger natural areas with broader ecosystems are required to ensure a foundation for biodiversity to be maintained (Rahbek & Manghezi, 2023, p. 2).

> *"Instead of having a discussion and saying that some places must be built, then you can discuss whether it is placed correctly. Because Copenhagen depends on the fact that when we make a green city, we can of course always go out and plant a flower, and when it dies, we can plant another and plant another. But if we*

take the rest of biodiversity, there will be no... You don't go out and plant a hoverfly. So, it has to come from somewhere. And the places where the things, the animals, that have to come into the city, what has to make it green, it has to come from somewhere. And it must come from the large natural areas. So, Copenhagen is completely dependent on the fact that there are large green areas around Copenhagen, which it entered" (Rahbek & Manghezi, 2023, p. 9).

Although Jernbanebyen could be considered a lonely island in the middle of a densely built-up area with large facilities, the site provides the benefit of being neighbor to Banedanmark's (the Danish Railway Company) railway terrain to the north and west. Basic analysis done around the railway terrain next to Jernbanebyen, see above picture, show that the nature quality is high in the area (Miljøstyrelsen & Banedanmark, 2018, pp. 28–29). Further, the biodiversity strategy conducted by MeMe showed registration of the current situation in Jernbanebyen, and most of the high structural and species quality habitats are located to the north and west part of Jernbanebyen (Metropolitan Metaculture, 2018).

A governmental agreement was established for a pool of 150 million DKK to be utilized in projects to increase biodiversity along roads and the railway as part of the infrastructure plan 2035 (Regeringen (Socialdemokratiet) et al., 2021).

Banedanmark recognizes the potential its network of railway tracks throughout Denmark has to strengthen biodiversity, as the tracks serve as dispersal corridors and barriers (Miljøstyrelsen & Banedanmark, 2018). Thus, they have made efforts to focus on making measures to strengthen biodiversity and help the spread along the tracks (Miljøstyrelsen & Banedanmark, 2018).

Implementation at Jernbanebyen

There is great potential in adapting initiatives in Jernbanebyen that can benefit from the track fauna from the railway network, as Julie from MeMe states:

"*DSB created snowdrift hedges, where they have used trees, bushes and planted them all along the tracks preventing snow cover. And now they brand themselves on having Denmark's longest forest edge. And forest edge is an extremely important ecological corridor for a variety of birds, hedgehogs, deer, insects and such. The railway network also has this dry, very interesting substrate composition. Habitats Infra Nature Report has assigned the track area in connection to Jernbanebyen as a flower-rich grassland, which have high nature value. The report shows that there are quite a few places along the Danish rail system, which have a high natural quality. So, this 'track fauna' is definitely an important ecological corridor that we can connect to*" (Hvid, 2023, p. 11).

Julie further expresses that by recreating the special railway habitat structure on e.g., the roofs of Jernbanebyen, the species can have greater spreading possibilities (Hvid, 2023, p. 9). The potential of biodiversity on roofs is elaborated in section 8.3.

The master plan of Jernbanebyen includes a 'green weave' being a network of nature that must spread biodiversity within the district. We suggest that similar connections are implemented to the surrounding local areas, even as a strategy for the entire municipality. It is crucial to emphasize that small green spots in the city cannot increase biodiversity, as Carsten argues (Rahbek & Manghezi, 2023, p. 9) that it must originate elsewhere. The biodiversity will not spread, if the distances are too big. Thus, for the 'green weave' in Jernbanebyen to succeed, it has to be connected to the surroundings. Crossing weaves across municipal boundaries are known from the 'Fingerplan' for Copenhagen's urban development (Indenrigs- og Boligministeriet, 2019), but the niche of considering crossing of species for the benefit of biodiversity is only at an emerging state.

Own picture, Jernbanebyen

8.2 Structures inspired by nature

In the *Municipal Plan 2019* for Copenhagen, the mentioning of biodiversity is linked to being part of the development of open spaces and green and blue structures in the city (Københavns Kommune, 2019), which insinuates where biodiversity should be considered in urban development of Copenhagen. But even though plants and trees have had peace to grow in parts of Jernbanebyen, the value of some of these well-established ecosystems have already been diminished in the planning process of the placement of the building plots. For example, the significant oak tree, which is greatly beneficial to the ecosystem, must give away for a big parking garage and additional nature is replaced by artificial grass pitches (Hvid, 2023, p. 3–4).

According to Rasmus Vincent from Habitats, the awareness of the biodiversity crisis presents an occasion to rethink how buildings are designed (Dagens Byggeri, 2021) and to find methods of integrating biodiversity-related measures into architecture while distributing responsibility to prevent biodiversity from becoming an afterthought. Habitats co-developed the report '*InfraNatur*' about future management of the overlooked nature of cities and infrastructure (Miljøstyrelsen & Banedanmark, 2018).
While cities and nature often appear as being separate, there are instances where nature attracts to man-made structures (Hvid, 2023, p. 12) like the landscape and natural foundations at Jernbanebyen (Metropolitan Metaculture, 2018):

> *"The peregrine falcon has been missing from the Danish landscape for many years. And then a breeding pair came back to Møn from Germany and spread along the coast over the last 20 years or so. And now it is nesting in the chimney at Vestforbrændingen. So, it's a huge success story that the peregrine falcon has come back, and it really likes man-made structures so much"* (Hvid, 2023, p. 11).

Implementation at Jernbanebyen

The focus on climate-friendly buildings in renovations of older buildings and new construction removes possible cracks and hollows that animals, especially birds, take advantages of to place their nest (Hvid, 2023, p. 12). Thus, these places must be implemented in our constructions as Julie (MeMe) argues:

> "*But when we do super-efficient climate renovation, and cover all the cracks and hollows, we cover all the great nesting spots – so now the nest sites previously used by e.g., swifts are closed, so now where should they be? But climate renovation is good for the climate and a really good thing – so we have to come up with a solution on how to integrate nesting places for birds and swifts, by using nest boxes etc. We have to create cities for co-habitation, where we make room for urban fauna. This would not only benefit biodiversity but also*

our climate. The city and nature are not opposites, there is an extremely large amount of fauna that is attracted to the urban environment" (Hvid, 2023, p. 12).

Nestbuilding on ledges and warm attics, collecting crumbs of food or peace from being hunted are some of the advantages many animals have found by adapting to a life in the city (The Danish Outdoor Council, n.d.). By considering biodiversity in the planning of buildings, it is possible to intentionally incorporate similar structures for nesting as well as other natural elements. This could be creating notches in the side of the buildings for nesting and in other ways imagine the city's fauna (Hvid, 2023, p. 12).

DGNB certification, which is a target for the stakeholders, involves extensive renovations and has great potential to support focus on habitats during renovation. DGNB emphasizes biodiversity and thus, an emerging focus on habitats through renovation is possible (Rådet for Bæredygtigt Byggeri, 2020).
Combining initiatives for biodiversity and ecosystems in Jernbanebyen's architecture will strengthen the district's biodiversity and create a focus on alternative initiatives for green elements in urban development. As Jernbanebyen's future construction is not planned yet, nature-inspired structures could still be implemented. But as Julie expresses:

"*We are still in the early stages, so we need to gather knowledge and enough experience to tell, how to succeed, and what are the success criteria anyway?*" (Hvid, 2023, p. 12).

Hence, structures inspired by nature is, at least for the stakeholders, a niche innovation that needs to be developed in order to be implemented successfully.

Own picture, Jernbanebyen

8.3 Biodiverse green roofs

Green roofs have been mentioned in the *Copenhagen Municipal Plans 2011* (Københavns Kommune, 2011) and subsequently also included in various zoning laws. Green initiatives on roofs can have various functions and purposes e.g., urban agriculture, leisure, climate adaptation, and placement of solar panels, and depends on the provisions of roof surfaces described in the zoning law. However, implementation of biodiverse green roofs, which are roofs with grass, sedum etc., often comes second to the above-mentioned measures (see Appendix C - Zoning law descriptions examples), but we find it as a boost for biodiversity and ecosystems at Jernbanebyen.

Evidence of the benefits of green roofs boosting biodiversity and ecosystems is very limited (Wooster et al., 2022) and thus, it should not be thought to be equally nurturing as ground level urban habitats (Williams et al., 2014). Nonetheless, it can be seen as an extension and a positive utilization of limited space for biodiversity. An experiment done in Sydney, Australia, compared biodiversity on two neighboring and identical buildings by counting specific forms of species, where one building had a conventional roof and the other a green roof (constructed with the aim of promoting biological diversity), the results from this experiment can be seen in Figure 12 (Wooster et al., 2022).

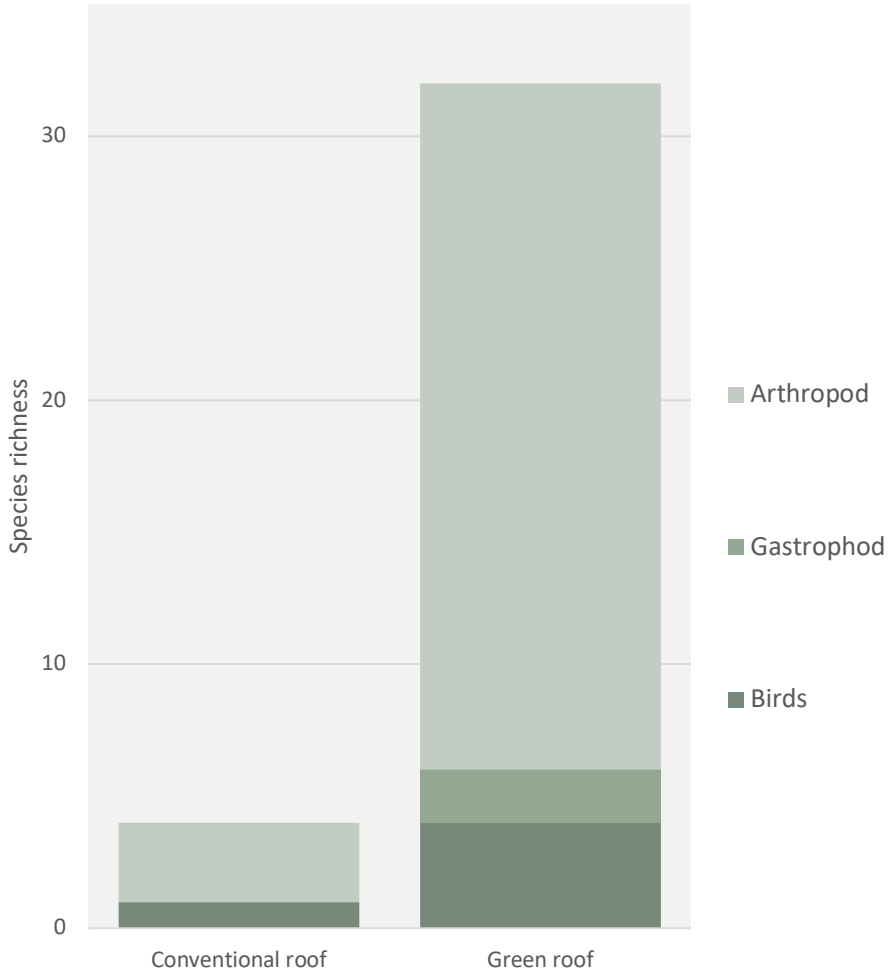


Figure 12 Results of species richness from green roofs versus conventional roofs experiment in Sydney, Australia (Wooster et al., 2022, p. 3). *Own figure*

The research demanded a lot of monitoring and equipment, but the results showed that there is great potential of green roofs giving a boost to the count of species (Wooster et al., 2022). To further enhance the potential of biodiverse rooftops, connections to the ground-level habitats are needed to be examined (Williams et al., 2014).

Implementation at Jernbanebyen

To maximize the biodiversity gains of biodiverse green roofs, the roofs should be designed in accordance with specific ecological principles (Williams et al., 2014). Therefore, adapting solutions in Jernbanebyen to the track's fauna by creating co-habitats on the rooftops could let nature spread into the area. Thus, the nature rich railway tracks in Jernbanebyen constitute a beneficial foundation for enhancing biodiversity at the green roofs.

In the interview with MeMe, Julie mentioned that green roof surfaces have great potential for untouched nature where people can observe and enjoy nature (Hvid, 2023, p. 12). Hence, roof surfaces in Jernbanebyen must be thought of as beneficial for both human and biological diversity (Hvid, 2023, p. 12).

As previously stated, green roofs are well-established in zoning laws nonetheless, their function has to be developed. In contrast to recreational places managed to appear beautiful and proper for human use, the function of roof surfaces as natural ecosystems and biodiversity is less common.

Own picture, Jernbanebyen

8.4 Insect hotels, sculptures, hollows, and piles of stone

Incorporating spaces where nature could grow wild and remain untouched would be most beneficial for biodiversity however, insect hotels are a great way to support insects (Danmarks Naturfredningsforening, 2021). Insect hotels appear in many forms like hollows in old trees, a pile of stone and even as man-made sculptures. For instance, some artists can create sculptures using recycled or biodegradable materials for insects to live in.

> *"But old trees with hollows and age-related defects are gold for biodiversity. So that's why we need more old trees in the cities!"* (Miljøstyrelsen et al., 2019, p. 10).

It is important to bear in mind that different insects require different habitats and elements like insect hotels can contribute to securing as many small environments as possible. For example, bees need to live in a dry place away from the ground, and earthworms require a moist area at the soil surface.

> *"Mowing and pruning: There are no large animals left in the landscape, especially not in urban nature, so we can mow and prune so that it causes damage that will lead to veteranization in the long term, and which lets the sun get down to the soil. It is almost blasphemy to talk about deliberately harming trees, but it is beneficial for many species, from bats to beetles and fungi"* (Miljøstyrelsen et al., 2019, p. 10).

Implementation at Jernbanebyen

One suggestion is that those in Jernbanebyen who have terraces or balconies on the first floor could have ready-made insect hotels. Further, a competition could be held where artist should create sculptures, maybe in bronze, that are inspired by the cultural heritage of the area, for example a train-like sculpture. This could also support Jernbanebyen to become a place full of cultural life, which could attract both Danish and foreign tourists.

The demolishing of the old oak in Jernbanebyen, mentioned in 8.2, has a great impact on biodiversity, as the older the tree is, the greater contribution to ecosystems and biodiversity (Hvid, 2023, p. 8). Thus, it is necessary to preserve as much of the ancient nature that contributes to biodiversity as possible.

The use of old trees with hollows deviates from the regular operation of nature in cities but is emerging several places in Copenhagen such as in Ørestad (Kjørup Rasmussen, n.d.).

8.5 Light pollution

Globally, light pollution is increasing and an estimated 80% of the world's population live under a 'lit sky' (Cities With Nature, n.d.). Earth's amount of artificial light increases annually by 2%, and the use of artificial light at night substantially increases (Cities With Nature, n.d.). Within the city, artificial light is both used for safety reasons and for aesthetic purposes e.g., by illuminating churches at night (Cities With Nature, n.d.).

Light pollution is "*the excessive or inappropriate use of outdoor light*" (National Geographic, n.d.). It is an issue, because it "*alters the natural patterns of light and dark in ecosystems*" (Cities With Nature, n.d.), and it is an often underestimated factor in the great loss of biodiversity and species.
Two thirds of the planet's species are nocturnal and even more depend on the interplay between darkness and light (Miljøpunkt Østerbro, n.d.). Use of light modifies the natural environment and impacts wild animals, plants, and functions of entire ecosystems (Cities With Nature, n.d.). Without darkness, the species cannot reproduce, find food, or orient themselves (Miljøpunkt Østerbro, n.d.).

> "*A species affected by light pollution is Lille Frostmåler, one of Denmark's most common nocturnal butterflies. The butterfly uses the night to eat nectar and mate. But if there is electric light form e.g., a streetlamp nearby, the butterfly becomes so attracted to the light that it forgets anything else. This can have major consequences for the population*" (Miljøpunkt Østerbro, n.d.).

station and the '*voluntary routes*', which often exists as alternatives to the necessary ones (Karin & Nørgaard, 2007).

Implementation at Jernbanebyen

Jernbanebyen has the opportunity to consider light pollution in park areas, roof terraces, and green walls among other things before the construction phase. With the many initiatives in favor of biodiversity that potentially will be implemented in Jernbanebyen, attention on light pollution is necessary.
It is more beneficial to prevent harming local species by using light that falls, is veiled, and only illuminates a small area, so that only the object to be illuminated can be seen from a distance. Additionally, nocturnal species can move more freely, and the night sky is not affected (Astronomisk Selskab, n.d.).
Given the importance of street lighting to residents' sense of security (Karin & Nørgaard, 2007) light pollution in Jernbanebyen cannot be entirely eliminated. A study shows "*that people compensate for a lack of lighting by taking a route detour. It also indicates that good lighting creates security and that it is important that you as a planner examine the lighting in relation to the security aspect and the desired use of and traffic in the urban space*" (Karin & Nørgaard, 2007, p. 16).
There is a distinction between the '*necessary routes*', which are links between central functions such as a main street and a train

The two essential features needed for the feeling of safety are that it should be possible to recognize faces and that the route feels illuminated. However, according to experts this is possible to achieve with relatively little lighting, as long as it is the correct lighting (Landsbyggefonden, n.d.). Therefore, ensuring minimal light pollution at Jernbanebyen together with the citizen safety and feeling of security involves establishing an interdisciplinary partnership with leading experts in lighting and security.

Own picture

8.6 Partnerships

Partnerships between landowners and residents, associations, municipalities, or companies may result in joint participation in future operations of the city's green areas (Naturstyrelsen, 2014). However, it is essential that this is initially made possible by certain operators in order for zealots to potentially contribute to the functioning of nature. This will also guarantee that the investments assist the area's biodiversity (Nielsen, 2023, p. 9).
At Jernbanebyen there will in the future be opportunities for establishing partnerships in the area with the primary school, institutions, private companies, and other neighbors. Already through the planning process it has been important for DSB Ejendomsudvikling to establish good relations to their neighbors (Gleesborg, 2023, p. 4). Additionally, partnerships can also have importance in the initial phase of a project to ensure that the project gives maximum profit for all partners (Naturstyrelsen, 2014).

Through establishing a partnership with the school in the area, the school can help cultivate nature such as herb gardens, and the students can become aware of what nature can contribute in terms of resources. Nature can be used as a learning medium, as the school in Jernbanebyen is positioned surrounded by nature and can create a basic understanding of biodiversity. All efforts, no matter the scale, enable us to understand biodiversity and, ideally, inspire us to take action to reverse its decline (Rahbek & Manghezi, 2023, p. 16).

Implementation at Jernbanebyen

Partnerships are common and hence not a niche innovation in itself, but collaborating to support local biodiversity is less frequent. One initiative to include in Jernbanebyen in collaboration with the school, could be a 'tiny forest' also termed a Miyawaki forest. At Østerbro in Copenhagen, a partnership between a school, the Municipality of Copenhagen and different associations including Urban Rewilders established a Miyawaki forest in the public park Fælledparken (Miljøpunkt Østerbro, 2022). The partnership and the establishment were not only about creating more and better nature but also about creating awareness and learning about the opportunities of nature within the city. The Miyawaki method means that many young trees are planted in a smaller area, so that they will reach for the light and grow faster (Miljøpunkt Østerbro, 2022). Miyawaki forests' native plant and tree species create a home for insects, birds and possibly mammals and contribute greatly to biodiversity (Miljøpunkt Østerbro, 2022).
Institutions such as a kindergarten benefits from having many natural areas that children can play within. Staying in nature is an essential investment in the well-being of children. Children who have positive interactions with nature become closer to it and want to protect and use it to a greater extent (Danmarks Naturfredningsforening, n.d.). They gain an understanding that humans are part of something bigger and mutually depend on it. Using nature reminds us that it is our basis for life, providing us with fresh air, clean water, food and the opportunity to survive together with millions of other species and organisms (Danmarks Naturfredningsforening, n.d.).

Another initiative is to create a dialogue with the private companies in Jernbanebyen about managing their areas by letting nature grow wild. Many companies desire to contribute to biodiversity, but they are not necessarily experts on the subject (Rahbek & Manghezi, 2023, p. 14). By letting nature thrive naturally, they support the overall agenda of Jernbanebyen and move the wild nature niche in urban areas closer to the regime.

Own picture, Jernbanebyen

8.7 DGNB Planet

DGNB Planet forms part of the DGNB certification and was introduced in the 2023 edition (Rådet for Bæredygtigt Byggeri, n.d.).

> "*DGNB is a sustainability certification targeted at buildings and urban areas. The system is based on the holistic approach to sustainability with the three pillars: social, economic and environmental sustainability*" (Rådet for Bæredygtigt Byggeri, n.d.).

The implementation of the original German DGNB certification in Denmark began in 2012 and have throughout the years already affected the construction industry towards more sustainable approaches (Rådet for Bæredygtigt Byggeri, 2023).
DGNB Planet exclusively focus' on the environmental aspect dealing with e.g., climate, biodiversity, and land use. DGNB Planet can only be achieved through a certification of buildings and consists of a number of knock-out requirements, which must all be met in order for the distinction to be achieved. Additionally, DGNB Planet must be maintained via annual reporting of both the obligatory biodiversity strategy and energy consumption in the buildings (Rådet for Bæredygtigt Byggeri, n.d.).
The approach of DGNB Planet is to ensure that the construction industry operate within the safety zone of the planetary boundaries (Rådet for Bæredygtigt Byggeri, n.d.). Until now, requirements for 4 out of 9 planetary boundaries are included, and the rest will be implemented in the longer term (Byggeri + Arkitektur, 2023). DGNB Planet will only reward projects that have the greatest focus on the boundaries and thus probably only a few will be able to achieve it (Rådet for Bæredygtigt Byggeri, 2023).

Implementation at Jernbanebyen

Since biodiversity is a key component and Jernbanebyen strives to be DGNB certified, it provides an opportunity to engage with DGNB Planet.
The DGNB method has been used by MeMe to develop Jernbanebyen's biodiversity strategy and is thus already implemented in the stakeholders' project development. Additionally, the stakeholders have shown a desire to fulfill the majority of DGNB's requirements:

> "*In Jernbanebyen we work with the sustainability certification DGNB, where both developers and Cobe have great interest in as many biodiversity criteria as possible are being met in the project*" (Jeppesen & Hvid, 2023, p. 10).

One of the most far-reaching requirements in DGNB Planet is that construction must only be built on areas that previously have been used for construction (Byggeri + Arkitektur, 2023). However, as the site of Jernbanebyen is a brownfield area, the project will be able to fulfill this requirement.

By achieving DGNB Planet, Jernbanebyen would be able to brand itself as a sustainable district with a strong focus on biodiversity and contribute to construction and cities being developed within the planetary boundaries.

Own picture, Jernbanebyen

8.8 Sub conclusion second analysis

In the second analysis we have investigated some of the possible niches that can preserve and enhance biodiversity at Jernbanebyen. Below sub conclusion is a summary of our results. In our Recommendations in section 10 our final proposals can be found.

Sustainability is the anchor of the development of Jernbanebyen and is incorporated through a green weave however, one green 'postage stamp' within the city cannot maintain and enhance biodiversity alone. But by creating a structure in Jernbanebyen similar to the railway track and terrain next to it e.g., on the buildings' roofs, the site's biodiversity can spread and be supported. This can further be incorporated in an overall green network in the Municipality of Copenhagen, which is essential for biodiversity to thrive in the city.

Despite the good intentions of the area's stakeholders, some green elements with biological diversity will be demolished according to the initial plan. This is potentially due to planning the building plots' placement before understanding nature's contribution, which also affects humans, but by creating partnerships around nature supporting biodiversity, the necessary awareness of nature can arise and encourage preservation.

Further, green elements must be integrated into the architecture of Jernbanebyen, and biodiversity must not be an afterthought in the urban development. Thus, it is necessary that the developers are aware of cracks and hollows used for nesting when creating or renovating constructions. Furthermore, space at the site must be provided for fauna that supports species attracted to man-made structures and construction, and green roofs have potential for this. In addition, utilization of the roofs can contribute with space for untouched nature in the area.

Maintenance of biodiversity is often not carried out sufficiently, but the new DGNB Planet requires annual reporting of this and provides a biodiversity action framework. Hence, by integrating the criteria of DGNB Planet, the stakeholders have a tool to ensure maintenance of biodiversity at Jernbanebyen.

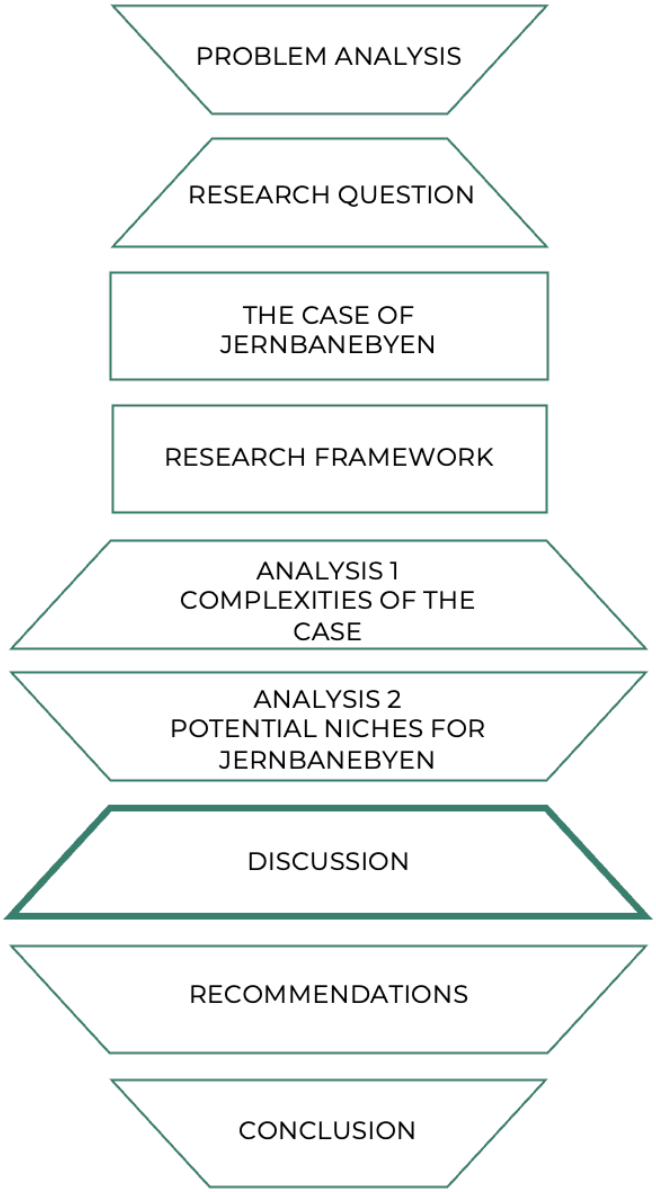
9 DISCUSSION

Based on the stakeholders' statements, we have been able to understand which possibilities for actions that the different stakeholders have regarding biodiversity as well as to present recommended niches. The vision for Jernbanebyen presents a new trend within urban development; the 'green city', which requires new planning approaches and experience to succeed. In addition, Torben from DSB Ejendomsudvikling desire more dialogue and collaboration supporting the stakeholders' vision for biodiversity.

The findings of both analyses are further elaborated in below discussion, where we broaden our perspective away from the case of Jernbanebyen. A note on our recommendations for the developers can be found in section 10.

Like our analysis, the discussion is separated into two parts: the first one returning back to the regime from the case at Jernbanebyen and away from the niches. Now looking at the overall regime and exploring what is necessary to change within the regime in order to create potential possibilities for the niches to break through and establish. The stakeholders have a significant influence on driving the biodiversity agenda forward, but they have no real authority in the MLP landscape challenges. To undertake this, we are using knowledge gathered from our initial research combined with our findings from both analyses.

Finally, in the last section of the discussion we are debating what is needed in the current urban development regime to support a paradigm shift and a transition towards integration of biodiversity in brownfield planning in cities.



9.1 City development and the sustainable city

As mentioned in section 7.2.1, the development of cities is colored by trends and societal tendencies. In Copenhagen, new parts of the city are often designed and developed as a response to the last previous developed part (Pedersen, 2023, p. 6), which results in a somewhat fragmented city. The fragmented development of cities is due to society and planners constantly becoming wiser and gaining more knowledge about what is needed in a city and for its citizens. Below quote from our interview with Karin from COWI is an example of this:

> "*So, you could say that when we started to clean up the inner-city center with these random backyards, it was an expression of the fact that we had this really bad public health. Some of these houses, which the medical association also built, it was again an expression of the fact that you could see that it was no use for people to live so close together, because then they got sick, you opened the moats, so people could come out*" (Pedersen, 2023, p. 9).

There are far higher expectations for cities today than there were a few decades ago, and there are particularly high expectations for major urban development projects (Uddannelses og forskningsministeriet, 2023). Today, it is no longer sufficient to be able to manage and grow a city with the fundamental needs of transportation, infrastructure, housing, places of employment, educational institutions, and recreational areas. Urban development initiatives today must be both environmentally friendly and economically and socially effective (Uddannelses og forskningsministeriet, 2023).

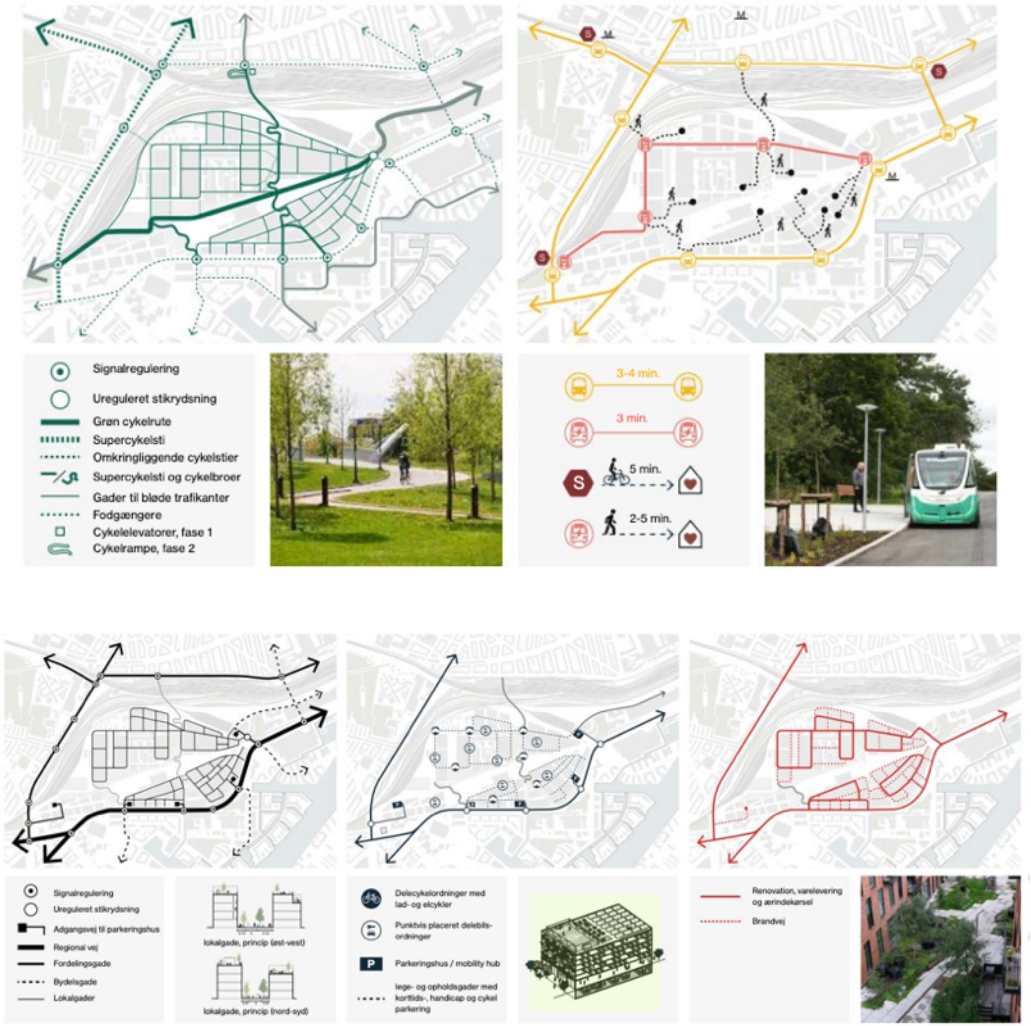
This puts extra pressure on new city development projects and is often subject to criticism, which is seen with other recent big development projects; Carlsbergbyen; too dense and not with enough care for cultural heritage (Ifversen, 2023), Nordhavn; to ugly and not sustainable enough (Abildlund & Kristensen, 2023), (Jørgensen, 2018) and Ørestad; too cold and too open (Kjeldtoft, 2016). Ørestad has an incredible bad reputation and for somewhat valid reasons (Kjeldtoft, 2017) however, what is often overlooked is that the original thought and ideas for Ørestad was in its essence a tribute to the ''old'' Copenhagen; intimate and cozy. But, when the city suffered heavy money shortages for the Metro, a decision was made to keep building floor upon floor resulting in more shadows and the ultimate conditions for wind turbulence (Kjeldtoft, 2016).

Own pictures, from left Nordhavn, Carlsberg byen and Ørestad

9.1.1 *Mobility and density*

Looking at above examples, planners clearly need to think about our cities in new ways, as even when it comes to sustainability, cities should be inspired by the natural world by looking at how all ecosystems are in cyclical patterns (Laposata & Withgott, 2015).
As described in above section, developing new parts of cites are not an easy task and furthermore, cities are resource 'sinks' having to import nearly everything they need from outside its borders (see section 2.4.1). Cities rely on land use (see section 9.4) and resources, but urbanization also preserves land, as people, services and goods being packed so densely together.

However, urban density does not come without a cost; there is not enough space for biodiversity in the city. In the visions for Jernbanebyen, a great emphasis has been placed on the term '*a sustainable district*' where the concept of mobility (Picture 7) also plays an important role.



Picture 7 Mobility concepts in Jernbanebyen's visions found in the Master Plan conducted by Team Cobe (Cobe et al., 2021, pp. 28–29).

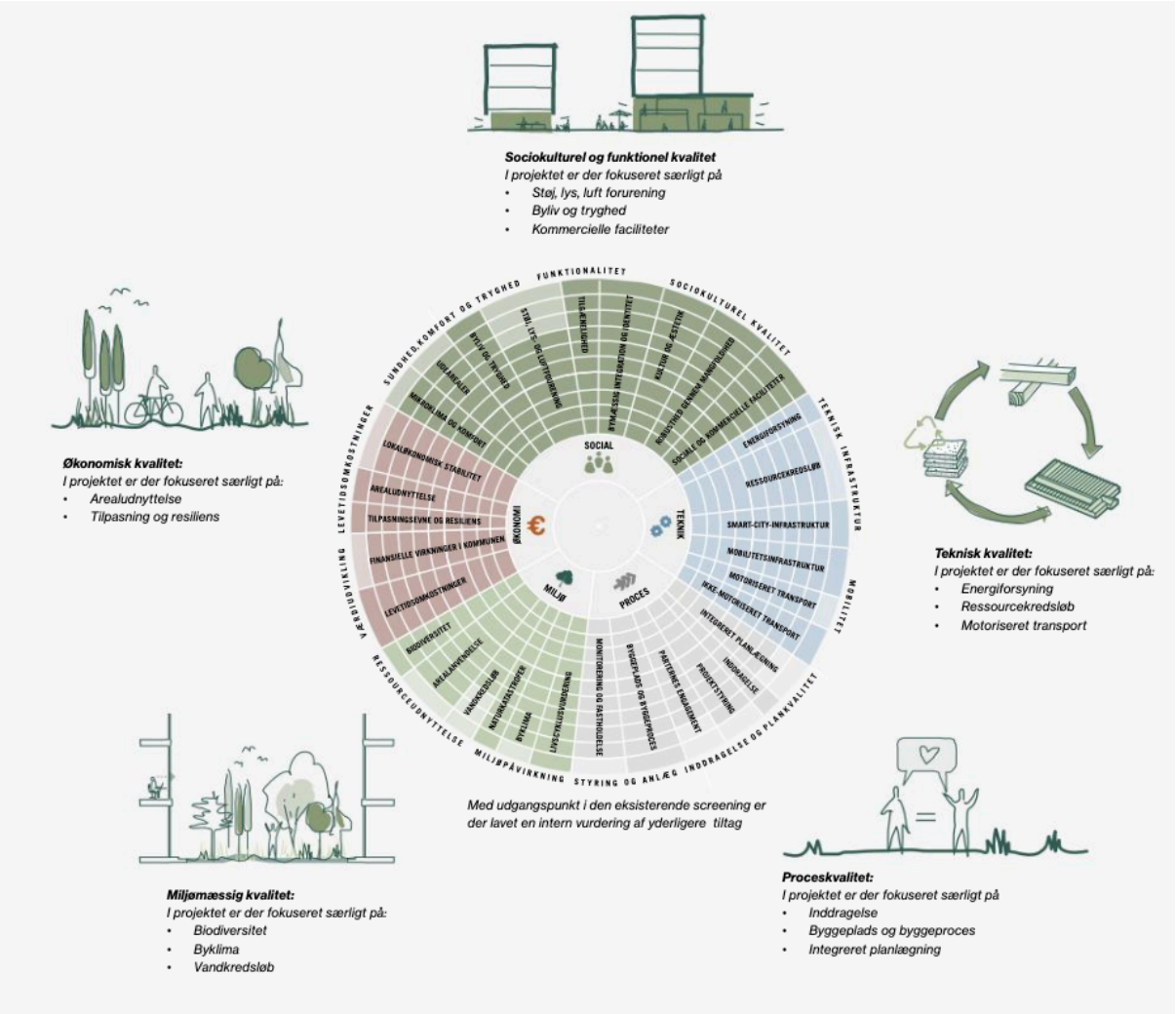
Mobility in a sustainable city takes the greatest considerations to 'vulnerable road users' e.g., pedestrians, bike riders and wheelchair users. Further, it includes places with room to practice sports either alone or together and invites for movement (Holm et al., 2014). There is room for ambulances, deliveries, and public transport, but "*the time when 80% of the row's space was occupied by the 20% who drove a car, while the remaining 80% of the city's users had to walk along the house walls or bike in the gutter is completely over*" (Holm et al., 2014 p. 175). Mobility in a sustainable city is designed primarily for the 'self-propelled' individuals, resulting in relatively high density, which offers the possibility of short routes for groceries, institutions, and recreational activities (Holm et al., 2014). Short distances for everything a citizen could possibly need has been a criterion for the plan of Jernbanebyen. In our interview with Io and Mathilde form Cobe they explained how they designed based on the concept of the '15-minute city' combined with space for delivery trucks to park (Schønherr & Ballegaard, 2023, p. 10), (Cobe et al., 2021).

However, the short distance with the high density conquers a lot of space from biodiversity and for all the green elements a city desperately needs. According to Carsten Rahbek we need to clean up in our ideas of what biodiversity is and is not and further, rethink how we understand the combination between city development and biodiversity (Rahbek & Manghezi, 2023).

9.1.2 Green elements and mixed functions

Green elements are necessary in a sustainable city. Due to accumulated solar heat, pure stone cities might experience summertime temperatures that are 6-7 degrees higher than those of green cities (Whitford et al., 2001). Trees, bushes, and lawns increase evaporation, the warmer it gets, evaporation requires energy and in this way the temperature is automatically kept down. Cooling for the summer heat is not the only benefit, as green elements 'filters and breaks' the wind to avoid the turbulence that occurs when wind hits a hard object like a building wall (Holm et al., 2014b), as experienced in Ørestad. Besides lowering temperature and taming the wind, green elements are essential for drainage and seepage. Denmark is expecting an increase in cloudbursts and heavy rainfall, putting extra attention to the risk of flooding, here, however, compensation is often possible through our sewer systems and with rainwater basins (Klimatilpasning, 2016). But if our water is only lead through our sewages and into open sea, we do not re-create our groundwaters (Holm et al., 2014), and slowly but surely our drinking water supplies will be emptied out.

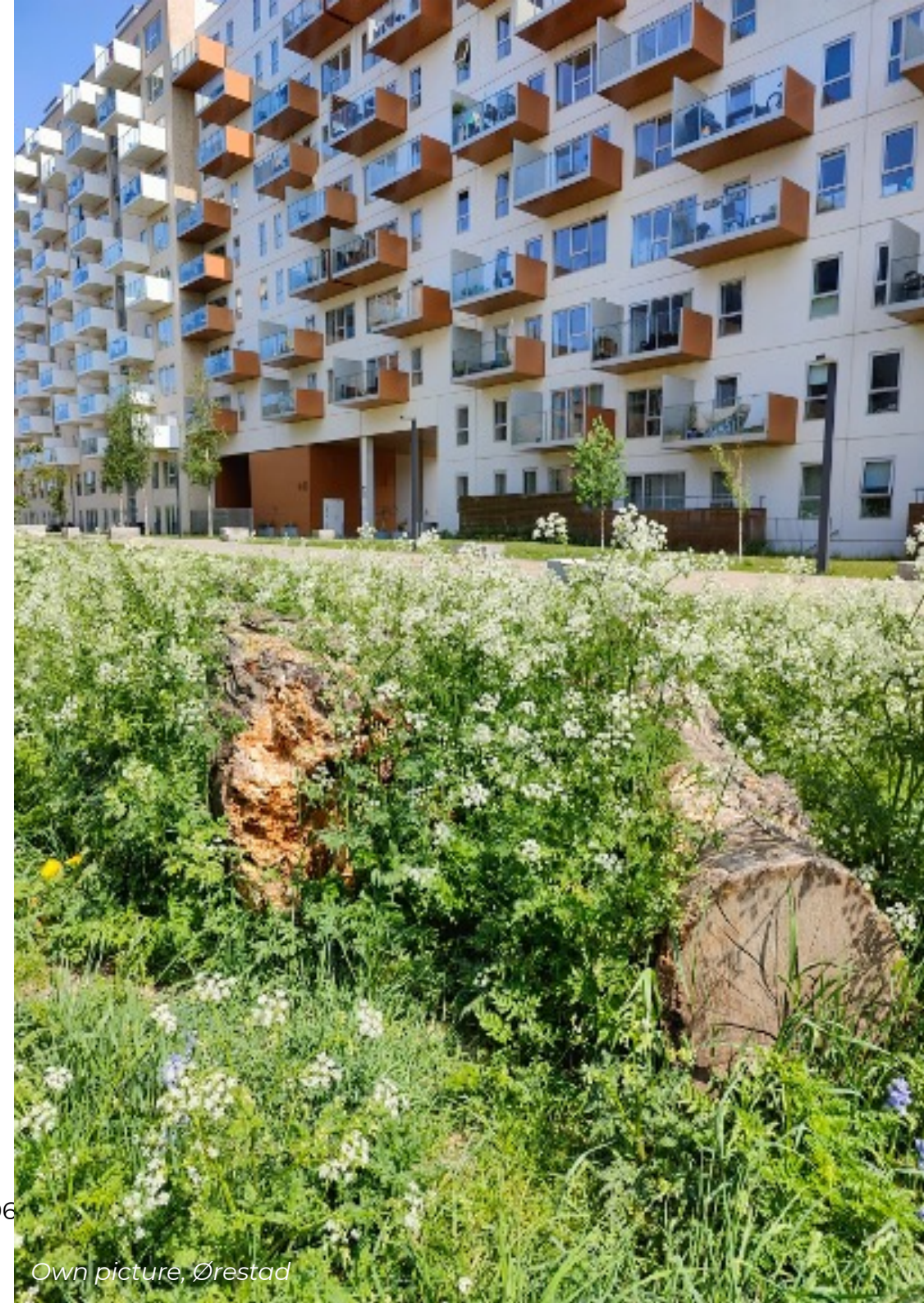
Lastly, the green elements are important to create a lovely and attractive city where people of all kinds choose to live. Thus, families do not move far away and need two cars to get back and forward to their jobs in the city everyday (Holm et al., 2014), and people can be surrounded by biodiversity and connect with nature.



Picture 8 Perspective of multifunctionality for Jernbanebyen conducted by Team Cobe (Cobe et al., 2021, p. 15).

Going back in history the 1800 cities were polyfunctional including mixed functions, but industrialization blurred city lines and contaminated the atmosphere, inspiring interwar modernists to propose how our cities should be split into housing, work, leisure, and transportation, which had an impact on Danish city planning from 1960 and onward (Holm et al., 2014). However, today a sustainable city is considered polyfunctional with a city-network with short distance for shopping and kindergartens, with buildings that are filled with mixed activities, from stores in the bottom, residences in the middle and green facades and roofs for biodiversity on the top. It is a multifunctional city with life day and night, with green spaces that are also polyfunctional, from recreational activities to seepages and shadow effects to biodiversity of high quantity and quality. Connecting this to the case of Jernbanebyen, Picture 8, illustrates Team Cobe's perspective of multifunctionality.

In conclusion, a sustainable part of the city must be effective from an environmental, economic, and social perspective. This is what various initiatives within the regime attempt to achieve. In the following section is discussed how the EU Taxonomy and certifications contribution to ensure that fragmented approaches in favor of sustainability become more united through regulations and their focus on restoration of biodiversity. Further, fragmented development including the planning of green spaces make us discuss how an overall plan for land use is essential on a regional level to secure room for nature as well as the need to exploit brownfields for urban development.



Own picture, Ørestad

9.2 EU's approaches in favor of biodiversity

When observing the regime with focus on biodiversity restoration, the European Union's approaches cannot be overlooked. The EU emphasizes the importance of maintaining natural ecosystems through several initiatives, regulations, and action plans such as the European Green Deal, see Figure 13 (European Commission, 2019).

Figure 13 The approaches of the European Green Deal growth strategy. The illustration is made with inspiration from (European Commission, 2019)*. (Own figure)*

The EU is an actor with high agency within the regime, as its parliament consists of elected politicians from all EU's member states, and they have power to impact and regulate actions in its member states (Folketingets EU-Oplysning, 2023b). However, it is difficult to assess how much legislation in Denmark is influenced by the EU, as the answer depends on how the legislation is estimated. In 2015, it is though estimated that the EU affects 14% of all Danish legislations directly (Folketingets EU-Oplysning, 2023a).

In the following is discussed the initiatives determined as important by the EU in order to maintain and increase biodiversity within urban development.

In 2019, the EU created a roadmap, the European Green Deal, to be able to become a climate-neutral continent by 2050 (European Commission, n.d.-a). The roadmap entailed several initiatives such as the EU Taxonomy and EU's biodiversity strategy. The overall goal of the taxonomy is "*to create transparency and disclose the impact of investments*" (Schrems & Bär, 2021, p. 6), which is further discussed in this section.
The headline ambition of EU's biodiversity strategy is to "*ensure that all of the world's ecosystems are restored, resilient and adequately protected*" by 2050 (European Commission, n.d.-c, p. 3). See further information in the 'EU's biodiversity strategy' box below.

9.2.1 The EU Taxonomy

The EU Taxonomy's (European Commission, 2020) main approach is to emphasize that it is not feasible to focus separately on one of its targets without ensuring that no harm is done to the other targets. The taxonomy is a classification system defining a sustainable economic activity through thresholds and six environmental targets (European Commission, 2020):

Thresholds:
1) make a substantive contribution to one of six environmental objectives,
2) do no significant harm (DNSH) to the other five, where relevant and
3) meet minimum safeguards (e.g., OECD Guidelines on Multinational Enterprises and the UN Guiding Principles on Business and Human Rights).

Environmental targets:
1) Climate change mitigation,
2) Climate change adaptation,
3) Sustainable and protection of water and marine resources,
4) Transition to a circular economy,
5) Pollution prevention and control,
6) Protection and restoration of biodiversity and ecosystems.

In order to comply with the taxonomy's requirements, one environmental objective must be the starting point for action, but at the same time none of the other objectives must be impaired. The taxonomy assists in measuring the sustainability of a certain investment for a company to progressively increase its share of sustainable economic activities (Schrems & Bär, 2021).

Further, the taxonomy strives to prevent any degradation of biodiversity through economic activities by including protection and restoration of biodiversity and ecosystems in its environmental targets. The fact is that cities take up 75% of all resources on earth (Rahbek & Manghezi, 2023, p. 14), and the issue of "*reducing pressures on natural resource consumption*" (Schrems & Bär, 2021, p. 4) within the taxonomy stresses the influence of an economic activity's value chain on biodiversity (Schrems & Bär, 2021). Therefore, it is essential that investors, among others, start reporting their value chain, and the taxonomy places this demand on investors and companies, states Carsten Rahbek:

> "*And what lies in the EU Commission's strategy and in the EU Taxonomy, and there will be more initiatives around this, is that it seems to have been decided that we will put pressure on the large companies and financial sectors in order to put pressure on the value chains. And that's what becomes difficult, because I want to say right away that I don't have the solution*" (Rahbek & Manghezi, 2023, p. 19).

In extension of that, Project Development Director at Pension Danmark, Mia Manghezi, argues that they as an investor are aware of how their value chain impacts biodiversity and aware of their responsibility. Further, she argues that by having expectation for all partners in a value chain, transformations can occur, and measurement can lead directly to action within the financial world (Rahbek & Manghezi, 2023).
The demand for urban development is present, but it must be done with greater success to protect nature. Hence, green agendas for cities creating green urban development and awareness of the entire value chain's imprint on nature is crucial (Rahbek & Manghezi, 2023). The biodiversity crisis cannot be solved without

the financial and private sectors, and the taxonomy is one of many essential impacts on the regime to change status quo.

However, the overall effect of the taxonomy dependent on its criteria, which must be ambitious and science based to enhance sustainability, for instance via SBTI (Science based targets). Further, the taxonomy emphasizes that if an activity is not biodiversity-friendly, it is not enough to perform better than usual (Schrems & Bär, 2021). But restoration and protection of biodiversity depends on the local context and is complex, challenging the defining of substantial contribution for the protection of biodiversity and ecosystem (Schrems & Bär, 2021).

The EU's Biodiversity Strategy

The EU's biodiversity strategy states that nature is in crisis. The changes of nature is seen when concrete blocks rise on green areas and wilderness dissolve (European Commission, n.d.-c). The strategy for biodiversity expresses that the world "*[...] need to step up the protection and restoration of nature. This should be done by improving and widening our network of protected areas [...]*" (European Commission, n.d., p. 3). This implicit emphasize the importance of developing brownfields instead of demolish natural areas. Further, it states that greening of cities contribute to the strategy's targets, and that it is important to create ecological corridors to allow species migration and improve healthy ecosystems (European Commission, n.d.-c). Thus, collaboration across the member states borders should be fostered, and the EU is aware that restoration of biodiversity require more than regulations and rather partnerships, citizens, businesses and commitment (European Commission, n.d.-c).

9.3 Certification

Another approach requiring documentation of sustainability is certifications, which purpose is to transform the construction industry into achieving a sustainable agenda and to ensure a solid investment for the owner and a building with a long lifespan. Within the regime, certifications act as a laboratory for the building industry to implement new innovations, and it has been seen that certifications have potential to impact the political sustainable agenda to require new targets for sustainability (Holm et al., 2014, p. 130). Certification standards acknowledge that the built environment has a significant impact on the biological diversity and ecosystems. This is done by among other things placing emphasis on local measures on or around the building and crediting measures for coherent habitats (Rådet for Bæredygtigt Byggeri, 2020).
Despite this, certifications do not question whether or not to build, as they are made for the purpose of building, but renovation of existing buildings through certifications is becoming more in demand. This is mainly in regard to energy gains, but it also benefits biodiversity through resource efficiency and land use protection (European Commission, n.d.-f). However, renovation can have negative imprints on biodiversity when e.g., hollow structures in construction are closed (Reid Brewin Architects, n.d.).

Despite the wide spreading implementation of certifications, the DGNB certification have been criticized for not requiring enough, as already today the most demanding certification criteria can be obtained:

> "*There are no measures embedded in the scale: nothing to strive for, nothing to compete on, no incentive to develop new methods or materials – no reason to do things differently*" (Johansen, 2021).

Conversely, the certification's targets improve the awareness of sustainability, and it strives to reflect the crucial development of sustainability over time.
As mentioned, (section 8.7), the DGNB certification standard includes targets for biodiversity, which aim to maintain and improve biodiversity on buildings and in the environs, and to limit the inclusion of new areas for development and infrastructure. Additionally, DGNB emphasizes that biodiversity requires effort at all levels of society and includes measures for coherent habitats and correctly operation of nature after creation (Rådet for Bæredygtigt Byggeri, 2020). But biodiversity only constitutes 2% of DGNB's criteria, which emphasizes the importance of adapting a holistic approach (Jensen & Birgisdottir, 2018).

The ecolabel Svanemærket aims to be holistic and through circular construction reduce the construction damage to the environment with up to 20-35% (Miljømærkning Danmark, n.d.-b). Circular construction gives the opportunity to save on the Earth's resources, as materials are able to be reused. One target of the certification is to affect the value chain through requirements for chemicals to reduce the environmental impact during production (Miljømærkning Danmark, n.d.-b). Svanemærket's requirements

depend on the product group, but in general it requires action to preserve biodiversity (see fact box) (Miljømærkning Danmark, n.d.). Despite certifications, ecolabels and the EU Taxonomy's requirement of reporting and targets to enhance biodiversity, there is in general a need for discussing the world's overall land use in relation to urban development and biological diversity, which in the following is emphasized.

Own picture, Carlsbergbyen

9.4 Land usage

The absent dialogue of land use and biodiversity must happen, as it is only expected that cities will expand in the following years (Ellen Macarthur Foundation, 2017). Urban planning must in the future occur through a holistic approach with nature as the focal point, as it is crucial. More land must be untouched nature and protected to potentially restore biodiversity.

9.4.1 Denmark's EU reporting

The EU has specific criteria on what can be reported as protected nature. The share of protected nature in Denmark is calculated by the Danish Biodiversity Council to amount around 2.3% (Rahbek & Manghezi, 2023). However, this does not prevent Denmark of reporting that the share is 17% by including protected cemeteries and Christmas tree plantations among other things (Rahbek & Manghezi, 2023). Hence, argued by Carsten Rahbek, Denmark is internationally infamous of doing greenwashing when it comes to our reporting of nature (Rahbek & Manghezi, 2023, p. 17).

Denmark has not yet had a serious discussion about what is needed for biodiversity on a national level. Out of the total share of nature in Denmark only 6% of it is in good condition (Rahbek & Manghezi, 2023). As mentioned in the problem analysis (section 2), Denmark is probably the country in Europe that has distanced itself the furthest from what nature is. But every small green spot rising within the city that makes up other than cement makes people start to take interest in it (Rahbek & Manghezi, 2023). Proximity to nature is essential for us to be able to participate in the debate on land use, as the green stamps do not protect biodiversity (Rahbek & Manghezi, 2023).

9.4.2 Overall urban planning approach

Human have destroyed 70% of the Earth's ecosystems, primarily due to farming, (Richardson, 2021) and thus, there is not much untouched nature remaining where species can live (Arler, Mosgaard, et al., 2017). The most often overlooked reason for great species variation in nature is space (Kjær, 2021) however, approximately half of the Earth's areas must be natural for the Earth to function (Rahbek & Manghezi, 2023). The more the landscape is characterized by the chaos of nature, storms, and overturned trunks, the greater the chance for a varied flora and fauna to emerge (Kjær, 2021).

The highest pressure on nature is depletion of natural areas for farmlands and the use of resources for the development of infrastructure and cities (Rahbek & Manghezi, 2023). Further, we must end claiming that when we build on natural areas, we improve the conditions for biodiversity, as this is greenwashing (Rahbek & Manghezi, 2023).

Society needs a better understanding of how biodiversity is restored through urban planning and is made successful. In order to do this an overall planning approach is essential. The way in which we use the Danish land today stems from legal regulations from the 1870s (Rahbek & Manghezi, 2023). In the future, we need to look into where we must have nature and hence locate other requirements such as production, wind turbines and infrastructure, and this must be decided through a land reformation.

> "*We have to look at it differently than plot by plot, so I think there is a municipal dialogue around urban development and biodiversity, which we have not seen yet, and which we badly need*" (Rahbek & Manghezi, 2023, p. 9).

As argued by Mia Manghezi (Rahbek & Manghezi, 2023), there is a dialogue about land use that needs to be taken by the municipality, as after all, it is the municipality that decides where to build.
Additionally, the Municipality of Copenhagen must decide on how Jernbanebyen can function as a green connection for biodiversity throughout Copenhagen and across several borders. Even though the municipality has drawn up a biodiversity strategy, "*there is a lack of an overall understanding of biodiversity in it, and the relationship between nature, i.e., the green fingers, and Copenhagen has been overlooked. You (the municipality) only deal with what is happening within the city*" (Rahbek & Manghezi, 2023, p. 10).
It is crucial to evaluate a site's natural value before beginning construction to see whether it is connected to a larger natural region and can serve as a spread for biodiversity. If the area has a low nature value but is connected to an area with importance for biodiversity, there should not be built on the area. As previously mentioned in (section 8.1), this negatively affects all the green projects that are inside the city, as they depend on biodiversity coming from somewhere outside city borders.
Despite this, Denmark has joined the EU's nature target to protect more land areas, which will affect Denmark to make a greater effort towards nature (Dansk Skovforening, 2022). The EU has committed to protect a minimum of 30% of the EU's land area and to integrate ecological corridors however, the Danish environmental minister Lea Wermelin claim that these 30% will not concern Danish land areas (Dansk Skovforening, 2020). Furthermore, to obtain the target it will require that brownfields or other previously built-up areas are included in urban development (Dansk Skovforening, 2022).
In the following, the possibility of an overall planned land use in Denmark is discussed by establishing an overarching collaboration to ensure holistic urban development that promotes biodiversity.

9.5 Biodiversity councils

Mentioned in section 8.1, biodiversity and ecosystems are organic matters and do not know administerial boundaries (Rahbek & Manghezi, 2023, p. 12). To support growth of biodiversity in Jernbanebyen and in Copenhagen in general, it is essential to ensure a biodiverse foundation by having links to larger natural areas with broader ecosystems (Rahbek & Manghezi, 2023, p. 9). In planning across administrative boundaries, it is important to have a common goal and there is motivation in having a concrete task to be solved (Horn-Petersen & Vejre, 2021). Creating connections to more established natural areas outside of the perimeter of Jernbanebyen is not managed by the landowners. These connections require cross-administrative planning e.g., through provisions on a municipal or national level.

An example of existing cross-administrative collaborative planning surrounding a natural ecosystem is the national directive of the watershed plans (Vandområdeplaner), which covers efforts to better conditions of water bodies in Denmark (Miljøstyrelsen, 2017). This directive is subject to the EU's Water Framework Directive (WFD) and includes measures on how to accommodate requirements set by the EU's WFD (Miljøstyrelsen, 2017). The Danish Environmental Agency manages the national directive, and the specific goal formulations can be seen in the text box 'Goals for the watershed plans are to achieve…'.

"Goals for the watershed plans are to achieve:

- *Better conditions in watercourses by improving the physical environment.*
- *Better conditions in fjords and coasts by reducing the discharge of nitrogen.*
- *Better conditions in lakes by reducing the discharge of phosphorus.*
- *Better conditions in watercourses and lakes by reducing contamination from e.g., homes without a sewer, treatment plants and overflow connection*" (Miljøstyrelsen, 2017).

The state formed a water plan for 2009-2015, which was heavily criticized, which led to municipalities and water councils taking a large part in the work (Kommunernes Landsforening, n.d.) and further, the establishment of the watershed plans (Miljøstyrelsen, 2017). Through this planning, Denmark is divided into 4 watershed districts (see Figure 14), where the geographical division is based on "*natural boundaries between the watercourse catchments and thus in principle independent of municipal, regional and national boundaries*" (Miljøstyrelsen, 2017). Within the districts the areas are further divided into 23 main watersheds (see Figure 15) based on the watercourse catchments, where watershed plans are implemented. As the areas belonging to the different watershed plans cross multiple municipal boundaries, the planning and implementation is through cross-municipal collaborations (Miljø- og Fødevareministeriet, 2019). However, each watershed has a water council in one of the catchment's municipalities, which is called the 'secretariat municipality' (Kommunernes Landsforening, n.d.).

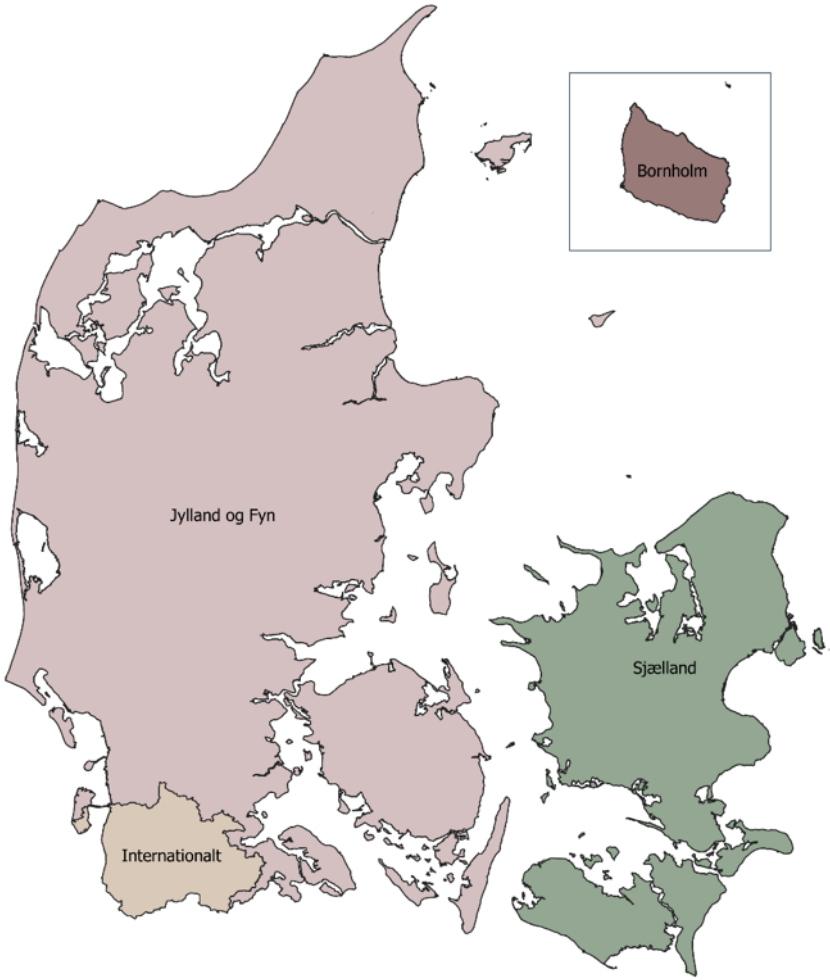


Figure 14 Own illustration of the 4 watershed districts with information from (Miljøstyrelsen, 2017).

The water councils consist of local representatives of e.g., agricultural associations, nature organizations and anglers (Kommunernes Landsforening, n.d.). This ensures local participation and knowledge contribution to the watershed plans, as the water council's role is to assist the municipalities in deciding which actions of restoration should be carried out based on assessments and knowledge of local conditions.

This bottom-up planning approach could also benefit the planning of biodiversity on a bigger scale, making sure that administerial boundaries do not create physical barriers, causing the organic matters of biodiversity and ecosystems to decline due to lack of communication. The city of Copenhagen is fully depended on bigger natural areas (Rahbek & Manghezi, 2023), see also section 8.1, and implementation of fragmented actions for biodiversity in the city are only somewhat symbolic without establishing connections to these natural areas and throughout the urban landscape.

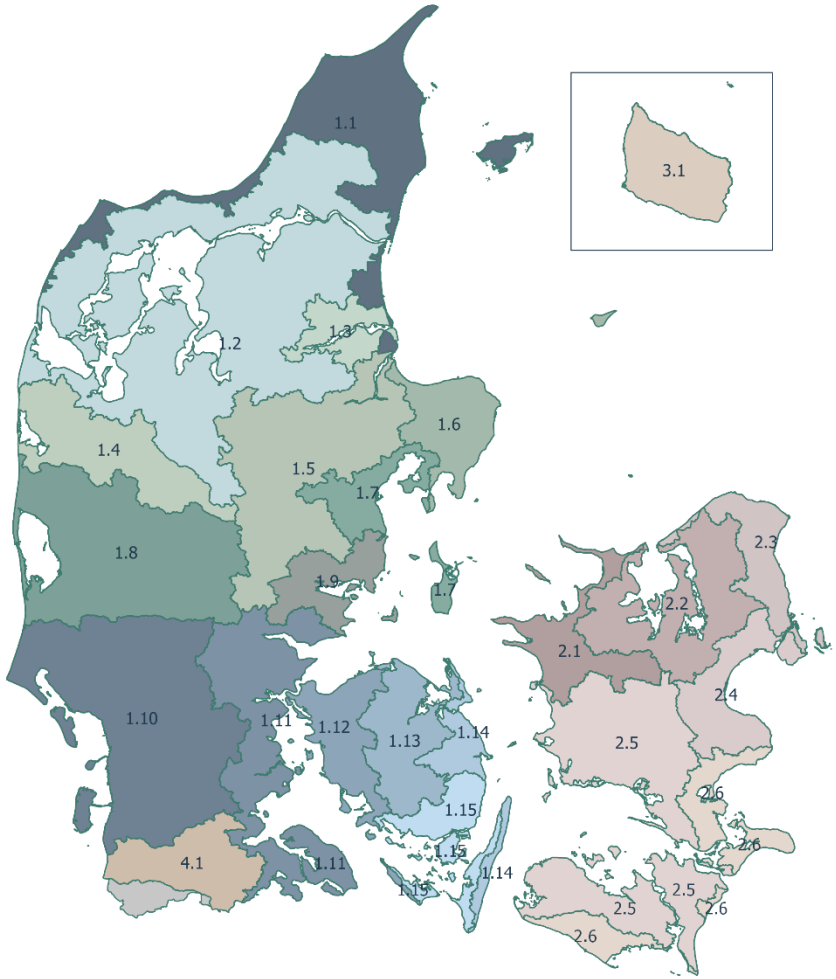


Figure 15 Own illustration of the 23 main watersheds with information from (Miljøstyrelsen, 2017).

9.5.1 Establishing connection

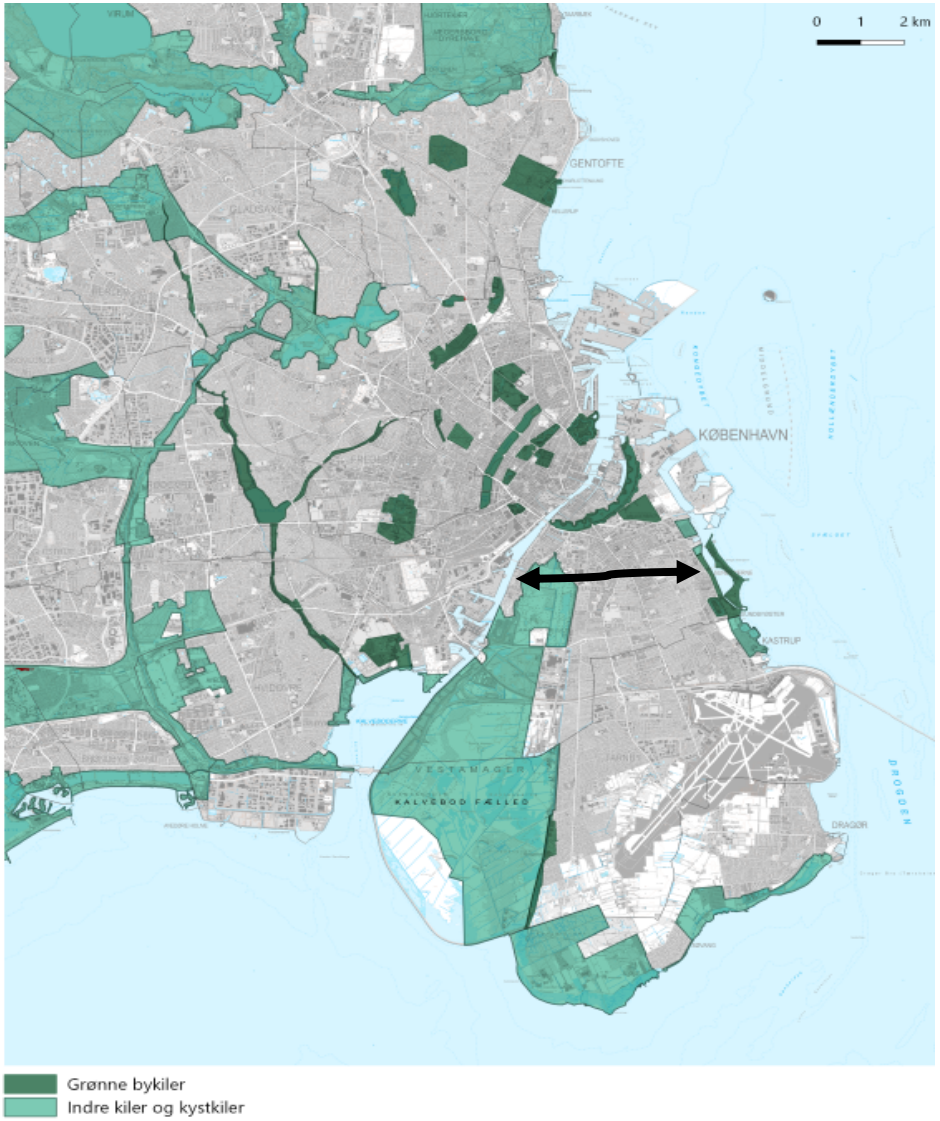
Existing plans that could lay foundation for these connections is the national planning directive in the capital area, known as the *Fingerplan*, which firstly was introduced in 1947 (Egnsplankontoret, 1947). It has been updated and adjusted several times since however, the latest plan was published in 2019 and its provisions apply to 34 municipalities on Zealand (Indenrigs- og Boligministeriet, 2019). The *Fingerplan* is now subject to the national Planning Act and sets requirements for the subordinate municipalities (Erhvervsstyrelsen, 2022). The main purpose of the plan is to set a framework for the physical planning in the capital area and has the goal of creating qualities for a well-functioning and attractive metropolitan area (Indenrigs- og Boligministeriet, 2019).

Biodiversity is not mentioned in the *Fingerplan,* as this is not the focus of this directive. However, green corridors and recreational trails, which ensure easy and quick access to attractive green areas and coherence within and across the municipalities, have been incorporated in the plans since 2007 (Hartoft-Nielsen Skov- og Naturstyrelsen, 2007).

Own picture, Ørestad

The provisions of the green corridors prevent establishment of facilities etc. in these areas, protecting them from being made into an urban zone (Indenrigs- og Boligministeriet, 2019). As these recreational trails can create connections to attractive green areas and are protected, there is an opportunity to anchor planning of biodiversity to these corridors, strengthening biodiversity by creating gateways for different faunas in the capital region. There are several existing green corridors in Copenhagen, Picture 9 as well as planned expansions (Indenrigs- og Boligministeriet, 2019).

In March 2023, the municipality of Copenhagen published a vision to combine planning of recreational trails and biodiversity by creating a green connection between Amager Strand and Amager Fælled (Københavns Kommune, Cobe, 2023). This vision shows commitment and interest from the municipality in combining planning of biodiversity with other initiatives like traffic planning.



Picture 9 Appendix F in the Fingerplan: Green city corridors (Indenrigs- og Boligministeriet, 2019, p. 22). The dark arrow shows the planned connection across Amager.

9.6 Market dialogue

Overall initiatives focusing on biodiversity, such as legal provisions and certifications, help to push the agenda towards making biodiversity a significant part of urban planning. Torben from DSB Ejendomsudvikling even explained that it has become a responsibility for the developers to incorporate initiatives for biodiversity (Gleesborg, 2023, p. 7). However, there is also a task in setting the bar for different aspects of requirements on a plausible level, which also ignites encouragement throughout the levels in the regime's hierarchy.

When integrating new initiatives, it may be necessary to acquire new practices or skills. New ways of performing certain tasks usually follow trends and tendencies; supply and demand is depended on societal context. As for now, the landowners have the responsibility of implementing initiatives supporting biodiversity. In the parallel assignment in the architectural tender the landowners set focus on supporting and strengthening biodiversity (Freja Ejendomme A/S et al., 2020). An interesting point in the tender was:

> "*To develop a visionary, marketwise, and financially feasible proposal for a master plan. [...] It is not expected that the participating teams work with economic models and estimates of income and expenditure in the competition phase, but that the proposals are based on solid experience with realizable master plans*" (Freja Ejendomme A/S et al., 2020, p. 60).

This point shows that there was given some leeway for the participating teams to be creative with their proposals however, within realizable limits. With biodiversity being a new objective of the urban development agenda, it is important to have room to conduct experiments and gain experience (section 8.2).

Biodiversity and ecosystems are not static, and it is therefore hard to predict how solutions will last over time. However, with the work MeMe and Banedanmark have conducted near the location of Jernbanebyen, there is a good amount of preparatory work done in mapping out existing conditions of the location's biodiversity and ecosystem.

A market dialogue will be beneficial in uncovering existing solutions e.g., by setting up workshops or an iterative process with the different actors (for instance the entrepreneurs in the area) discussing how to implement and care for biodiversity in Jernbanebyen. Additionally, this demand could initiate new developments or services to be evolved. Perhaps for biodiversity, a new type of contract or tender is required e.g., longer-lasting collaborations, which ensures that the preparation, establishment, and operation are more coherently planned.

9.7 Paradigme shift

In the previous sections we have outlined the problematic biodiversity crisis in relation to our case and the existing regime. We aimed to explore the stakeholders of Jernbanebyen's perspectives to understand possible niches to implement in the current urban development regime, whilst exploring what is needed for a paradigm shift.

In our research, we look at Jernbanebyen through the perspective of it being a possible lighthouse to inspire the planning of brownfields in the future, especially with a focus on biodiversity. In this final part of the discussion, we want to focus on the last part of our third sub question; *what is needed in the current urban development regime to support a paradigm shift and a transition towards integration of biodiversity in brownfield planning in cities?*

The discussion has aimed to examine global, regional, and local attempts that are leading towards changes of the existing regime in favor of biodiversity such as the EU Taxonomy and cross border collaborations. However, to answer our research question, we narrow our examination to concern the local existing urban development regime.

9.7.1 City development

On a city level, we must recognize that we cannot consider each of our cities as individual, because they are interdependent and interconnected to the planet (see section 9.1).

On the contrary we need to develop an understanding of our planet as a whole – we only have limited resources available, in section 9.2 it is stated how 75% of all resources on Earth is consumed in cities and that the value chains of this consumption need to be examined and optimized.
There is a natural unbalance between countries, cities, and rural areas resource consumption, which we have become more aware of with the concept of Overshoot Day (see section 2). However, we need to be aware of the intertwined connections of the whole system.

Since 2010, there has been a common agreement internationally to prevent the decline of biodiversity (Miljøstyrelsen, n.d.-b), which has not yet been successful (Miljøministeriet et al., 2012). The change of land use is one of the reasons for the loss of biodiversity (Miljøstyrelsen, n.d.-a), and as stated in the problem analysis, biodiversity is alarmingly declining, and it is urgent for society to take responsibility (Miljøstyrelsen, n.d.-a). Within cities, the road network spreads out and contributes to decline in areas of nature and biological diversity (Miljøministeriet et al., 2012). However, transformation of construction or establishment of new construction regards many options for considering strategies for improving the qualities of nature and biodiversity. Further, nature can increase the function of the building, provide experiences, and increase biodiversity (Rasmus Vincentz et al., 2013). Tendencies of society today reflect this issue in the development and a change of urban planning towards prioritizing nature to a greater extent. This is also supported by the Municipality of Copenhagen (Københavns Kommune, 2022a). In this research, the case of Jernbanebyen is

therefore relevant to examine because of the prioritization of green areas in the planning process for the future landscape.
Besides the barriers of Jernbanebyen, there is also a need for general understanding of what is necessary to enhance biodiversity. Within the municipality there is a focus on implementation of cross territorial ownership (Københavns Kommune, 2022a), as nature is not static. The development of new urban areas must therefore aim to represent the better sustainable development of the future and be a precedent.

We need to stop solving problems separately within each sector and thinking in silos. A holistic approach and an interdisciplinary understanding of our problems through a common system mindset are key to solving our issues (see section 2). However, by looking at how we tackle climate change, we can obtain an indication of just how challenging it will be to adjust. Furthermore, as we can never re-create extinct species (Richardson, 2021), the biodiversity crisis can be argued to be just as important than the climate crisis or even more (Richardson, 2021).

Own picture, Jernbanebyen

9.7.2 Sociotechnical experimentation

As stated in (section 2), agriculture is closely related to habitat destruction, and since we as a society are aware of these issues, we are compelled to take action.

However, dealing with transformation within systems such as agriculture in Denmark is filled with intertwined complexities, as it is deeply rooted in the nation's history and common cultural integrity. Even the Danish language encourages us to equate agriculture with food production; *landbrug = brug for land* (Richardson, 2021, p. 65). Nevertheless, there is a strong possibility that future generations will see food production differently (Richardson, 2021), and thereby combine solutions in new innovative ways. Nature in the sea also needs protection, and who says that we cannot link nature preservation, biodiversity, food- and energy production together, for instance; offshore wind turbines with artificial reefs at its base combined with seaweed production on its sides (Richardson, 2021, p. 68). It is all about combining knowledge in new ways, structures, and networks, as even though technology can help us along the way, we cannot rely on a quick fix from technological advancements and innovation:

> "*It is not because technology cannot do anything about the fact that the Earth's resources are inherently limited.*
>
> *&*
>
> *Nor can it create new biodiversity when our activities cause species to become extinct*" (Richardson, 2021, p. 52).

A crucial aspect of transforming the paradigm is therefore sociotechnical experimentation with original configurations of technologies or services in particular local contexts (Holm et al., 2014, p. 45). Local projects like Jernbanebyen can serve as the starting point for emerging changes in socio-technical systems by establishing frameworks for the reconfiguration of new and innovative local actor constellations, involving both human and nonhuman actors. These places can be described as situated transitions spots, as each of the emerging initiatives on the site has, on the one hand, been shaped by particular contexts, and, on the other hand, these contexts serve as the foundation for broad social and technical learning and development perspectives (Holm et al., 2014, p. 305).

Although transition processes are localized and take place in particular local contexts, under unique socio-ecological conditions, they are impacted and formed by local and regional actors, policies, and programs. Adaptation of socio-technical systems is about systematic changes in the regime (Holm et al., 2014, p. 304), which can happen by some of the presented topics in this discussion; the EU taxonomy (section 9.2.1), land use (section 9.4), and tender dossiers (section 9.6).

"*In these transitions, cities act as initial seedbeds for the creation of niches and the performance of entrepreneurial experiments with radical new technologies*" (F. Geels, 2011, p. 22).

In order for Jernbanebyen to become a situated transition spot claiming biodiversity, the stakeholders need to commit to an experimental process with all the actors involved. Furthermore, they have a responsibility to take initiative to increase pressure to alter the governance of development projects and to encourage

biodiversity in other brownfield development projects through their gain insight into and experience of what works and does not work.

According to Mia Manghezi from Pension Danmark, who is quoted below, there is support from investors for a reform in the law to provide them with more opportunities when investing: "*The second thing that we dream of doing is investing in forests*" (Rahbek & Manghezi, 2023, p. 24).
Actors such as the pension funds with significant capital power also have a customer base that is beginning to demand "better" investments (Topdanmark, 2021). It is the beginning of a transformation for corporate behavior in what ''good'' investments are, and it is a crucial step to the overall transition of the regime. For instance, the Danish pension fund Akademiker Pension plans to have 22,5% of their investments being in the green transition by 2050, which will be around 50 billion DKK in sustainable investments (Akademiker Pension, 2023). Indeed, the question of what a sustainable investment is, can be discussed, (Europa-parlamentet, 2020) but we refrain from this, as it is not part of this thesis' purpose.

Additionally, it concerns changing behavior on a personal and societal level. In science we discuss a lot about 'tipping points' e.g., Greenland's icesheets melting. However, 'social tipping points' also play a huge role for how we act and think about the world we live in e.g., how smoking went from something cool to something frowned upon (Richardson, 2021). These social tipping points can happen extremely fast and change our collective behavior (Richardson, 2021). The more biodiversity, green spaces, and other natural features that residents in cities are exposed to and feel a connection to (see section 8.6), the more likely it is that a social tipping point will occur and that a potential increased focus on biodiversity happens, which will create ripple effects throughout society.

9.7.3 The responsibility of the municipality

As with the issue of greenhouse gas emissions, it is possible that over time these ripple effects will exert enough pressure on both businesses and governments to change their current practices. It has long been established how in order to achieve climate targets, the industries that contribute to the production of greenhouse gases must modify their technology and behavior in unison with a change in governmental legislation (Holm et al., 2014). The same can therefore be said in relation to the biodiversity crisis, which we have established are just as important in section 2 however, "*If the municipalities are to contribute to local transition processes, they must not only be facilitators. They must act as strategic actors in a well-thought-out formation*" (Holm et al., 2014).

In our research, we have found it questionable that the Municipality of Copenhagen are willing to take an even more active role in solving the biodiversity crisis. Despite the development of their biodiversity strategy (see section 5.1.3.2), they are still primarily acting as facilitator. In our interview with Louise from the Municipality of Copenhagen, she expressed; "*We also have a biodiversity strategy, but we don't really know exactly how it will be handled in the zoning law*" (Ploug, 2023, p. 3).

Picture 11 Illustration of Lokomotivskoven made by Team Cobe (Cobe et al., 2021, p. 18).

Further, she explained that 'Lokomotivskoven' (Picture 11 and 12) in the area will be transformed into a public park, which they will be responsible for managing. Louise acknowledged that operating the green spaces correctly in the total area of Jernbanebyen is essential but something that is out of their hands. Even though they will manage some green elements, it seems that they will only do their responsibilities, and it can thus be argued that the municipality will not have an essential role in securing the success of biodiversity in Jernbanebyen.

Picture 10 Visual of the set scene of future Lokomotivskoven in Jernbanebyen (Cobe et al., 2021, p. 18).

As argued trough this discussing, fragmented solutions are not what is needed at the site: *"There are two general ways to respond to a problem. One is to address the symptoms and the other is to address the root cause of the problem"* (Laposata & Withgott, 2015, p. 688). Too often we treat our wicked problems with symptomatic treatment, but sustainability needs holistic and systematic approaches. At Jernbanebyen the stakeholders have tried to incorporate biodiversity into their plans from the beginning, but is it enough? Can Jernbanebyen be a lighthouse for future

development of brownfields and be part of the transformation of the paradigm?

9.8 Sub conclusion

In the discussion we have sought an answer for *what is needed in the current urban development regime to support a paradigm shift and a transition towards integration of biodiversity in brownfield planning in cities*.

Looking at city development, it has become clear that every time a new district is developed, it is a response to the last developed part of the city as well as a response to societal trends. Sustainable city development is thus contextual, and the last couple of district development projects in Copenhagen have had an emphasis on climate adaptation and now the need for more green spaces is expressed.
There is a need for local development projects that dare to initiate experimental processes and create experiences and knowledge that can be shared in interdisciplinary contexts. These local projects can be a part of creating a new innovative market dialogue where tenders set new standards for biodiversity and further incorporates certifications to an even greater extent than today.

Developers already have a financial interest in certifications as well as investment in certified buildings. Certifications help make measures tangible and further create incentives for experimentation and development. With the increasingly possible measures, the market is being adjusted, which eventually changes the legislation.
However, the use of certifications alongside with lawmaking requires a great degree of balance where the regulations do not become too strict but combined with certification provides some strong frameworks for developers (but we limit ourselves from elaborating on this subject in the thesis).

However, local projects cannot push the paradigm shift by themself. Success with biodiversity in cities only happens if they are connected to larger wild nature areas outside city borders hence, there is a need for cross boundary collaborations such as biodiversity councils. To add to this, we further experience the need for a huge land usage reform in Denmark and a need to rethink the use of our land areas. Further, local projects have very little effect, if Denmark does not take responsibility in preserving and protecting our country's biodiversity.

As a local project, Jernbanebyen can be used to gather experience through socio-technical experiments to support emerging biodiversity-related measure. However, the stakeholders must take responsibility through concrete initiatives in order for integration of biodiversity in brownfield planning to succeed.

Furthermore, as emphasized in above discussion, the Municipality of Copenhagen also bears responsibility and must be a strategic actor in the transition of brownfields in favor of biodiversity.
Finally, in the current urban development regime, a holistic approach and an understanding of the overall coherence between human and nature are needed to support a paradigm shift and a transition in urban development of brownfields. In addition, the integration of biodiversity can no longer occur through silos, but as expressed, must happen throughout a cross sectional collaborations, as partnerships on all levels are key to preserve biodiversity.

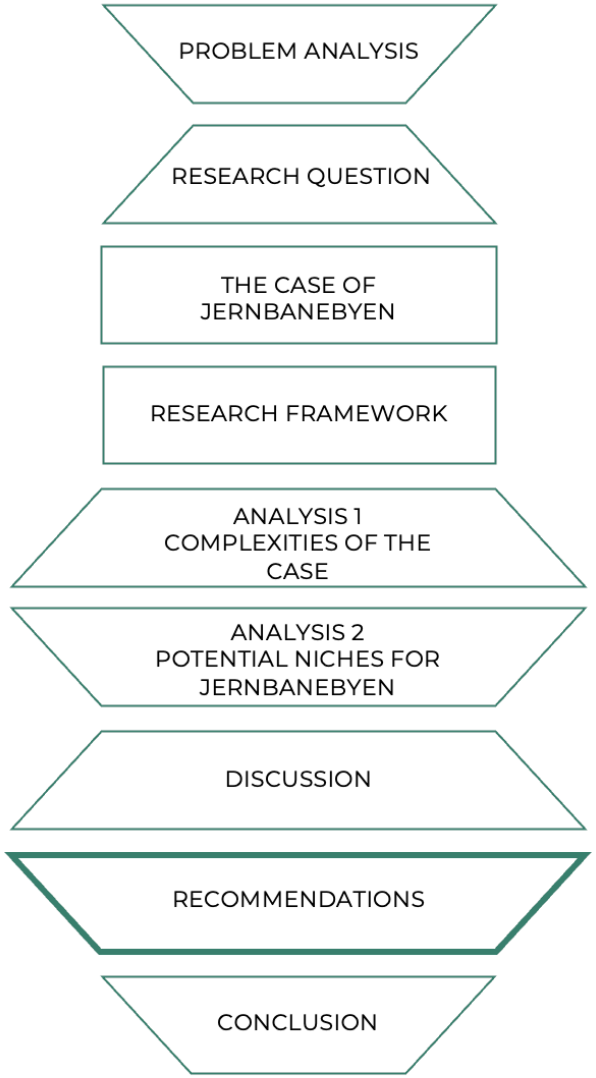
The report's concluding section will examine the specific measures that need to be implemented in local projects, in this case Jernbanebyen, in favor of a paradigm shift regarding biodiversity at brownfields.

10 RECOMMENDATIONS

The opportunity to explore the urban development project of Jernbanebyen has been exciting for us, and we have looked forward to providing our recommendations to the developers regarding biodiversity initiatives at the site. Jernbanebyen reflects societal trends in urban development and has the prospect to act as a model for subsequent developments that must give biodiversity a higher priority.

We acknowledge that the developers involved in Jernbanebyen have many good intentions and visions for the development of the site. However, as we want to contribute to their agenda and ensure that biodiversity is secured through the execution of the project, we have made this last section of our thesis as a note including our recommendations to enhance biodiversity at the site.

Biodiversity has been the core focus of our thesis and therefore, it is also the foundation for this recommendation note. The proposals are based on our research as well as the results from our analyses and discussion. As a result, we will reiterate perspectives from the thesis report to reinforce our perspectives, and we recommend exploring the report for a more complete background.



Ownpicture, Jernbanebyen

10.1 Market dialogue and municipal collaboration

The desire to implement solutions for biodiversity in cities and new urban developments is increasing however, legal requirements are still only in the works. This means that the responsibility of integrating biodiversity in Jernbanebyen, as for now, lies with the landowners.

The buildings in Jernbanebyen have not yet been designed, and it is therefore still an opportunity for the landowners to explore options on how the buildings and structures can contribute to enhancing biodiversity. Existing conditions of the location's biodiversity and ecosystems are mapped out through the work done by MeMe and Banedanmark. We recommend that the landowners make use of having this knowledge and utilize it as part of their tender dossier when specifying requirements for biodiversity in a tender. A tender could for instance require that the building or structure design should include hollows or birdhouses on the facades for shelter, roofs with partially untouchable nature or other elements for insects. To be sure that these requirements are realizable or give leeway for experimentation, and to ensure that offers are given to the tenders, it would be beneficial to start with a market dialogue.

We also find it necessary that the landowners continue to challenge fixed technical requirements generally set in zoning laws, which limit possible implementations of biodiversity in urban areas. Alternative establishments can be negotiated, and these general technical requirements can be modified to hold both implementation of biodiversity as well as maintaining technical standards. An example could be exploring synergies between e.g., biodiversity and areas for fire rescue, where firefighters can for instances run over or cut down trees during a fire rescue.

For biodiversity and ecosystems to thrive, connections to larger natural areas are needed. These connections have to be established on a municipal and a regional level. Here we see that the landowners of Jernbanebyen, through continuous exchange of learned experiences and dialogue with the municipality, can reinforce and push this development forward by insisting on its importance. While the municipality is establishing foundations for spreading of biodiversity into the city, Jernbanebyen has the opportunity to stand as an already biodiversity adapted district.

Own picture, Jernbanebyen

Own picture,

10.2 Local, contextual experiments for biodiversity

We aim to inspire the developers of Jernbanebyen to seek the opportunity to experiment with different initiatives for biodiversity through the development and operation of the site. With this, Jernbanebyen can constitute a laboratory for future biodiverse urban development.

Planning in favor of biodiversity is a rather unexperienced element of the urban development agenda and hence, it is important to carry out experiments, gain knowledge and share experiences.

We recommend the developers to have an innovative approach towards the development of Jernbanebyen in order to investigate new initiatives and explore new openings to embrace every possibility that can contribute to biodiversity thriving.

One initiative is a long-term plan to actively engage citizens involvement in the operation of the area's nature to enhance biodiversity. We believe that continuous collaborations with the citizens and Jernbanebyen's private tenants will contribute to a more coherently organized operation. Thus, we recommend the stakeholders to involve the citizens in the maintenance of the area's biodiversity through activities, workshops, and events such as an annual biodiversity day as soon as possible.

An example of an activity could be a route through Jernbanebyen with signage that informs about the species in Jernbanebyen, such as seen in the Botanical Gardens, and informs when a plant blooms in the year and further, make it a special occasion when something unique blooms. Another example is the Japanese cherry trees at Bispebjerg, which are highly popular among both the citizens of Copenhagen and tourist.

A group of entrepreneurs have already implemented an activity for active engagement with the green elements of Jernbanebyen such as *Bivejen* (Kultur- og Fritidsforvaltningen, 2020). Besides green elements, the route includes bees, chickens and blackberries and aims to spread knowledge about nature, biodiversity, and our shared Earth through communication in a physical character but also in the form of a podcast that can be listened to during the walk in the area (Kultur- og Fritidsforvaltningen, 2020).

With initiatives like this, the citizens will have something special to look forward to in Jernbanebyen, and this can serve as an opportunity to actively engage with the area's biodiversity, species, and plants.

Own picture, Bispebjerg

Own picture, Vesterbro

10.3 Light pollution

Due to light pollution, many species do not thrive in cities, but since Jernbanebyen is still being developed, the developers have the opportunity to rethink how to illuminate this part of the city.

A recommendation is thus to implement ‘smart’ lighting in some areas of Jernbanebyen. ‘Smart’ lighting solutions make it possible to reconcile human comfort with the well-being of species sensitive to light pollution. For example, some areas can be designated to have special, dimmed lightings, such as park areas or small sanctuaries, where flora and fauna can thrive, whereas some of the main road network can be illuminated.

Light pollution is a serious threat, and our recommendation is therefore to engage in an interdisciplinary collaboration with both experts in biodiversity and from the world of illuminating cities with a view to human safety.

10.4 Balancing species, monitoring & operation

Data collection and monitoring are crucial to maintain habitats and ecosystems in Jernbanebyen, and a strong foundation has already been established as a result of the mapping in the area that has been done. Continually obtaining information regarding the status of biodiversity supports the decisions that need to be made for biodiversity to thrive.

Our recommendation is thus to initially monitor and collect data of biodiversity on the site in one-year intervals for a five-year period. Further, during this period a collaboration with volunteers who could take over afterwards must be set up. This combined with council from experts such as MeMe will give indicators of what measures are necessary to implement. This knowledge can then be the basis for the day-to-day operation of the area in the future. Collaboration with and education of those who perform the day-to-day operation are essential to ensure the right competences and appropriately maintenance of the area's biodiversity long term.

Own picture, Ørestad

Own picture, Jernbanebyen

10.5 DGNB Planet

When Jernbanebyen's biodiversity strategy was developed, the stakeholders used DGNB certification as a framework.

Thus, it is a well-known method for them to accomplish their visions for biodiversity, particularly when the municipality does not have the authority to establish it through the zoning law.

Consequently, we encourage the stakeholders to raise the bar and set their ambitions towards achieving DGNB Planet. For example, certain building plots can be appointed where DGNB Planet has to be achieved.

The visions for biodiversity at Jernbanebyen and the stakeholders' holistic approach will be strengthened through the achievement of DGNB Planet and emphasize that they are determined on securing a sustainable part of the city where biodiversity is a top priority. Additionally, the stakeholders can appear as courageous actors and express that Jernbanebyen aims to be a lighthouse for future urban development projects of brownfields.

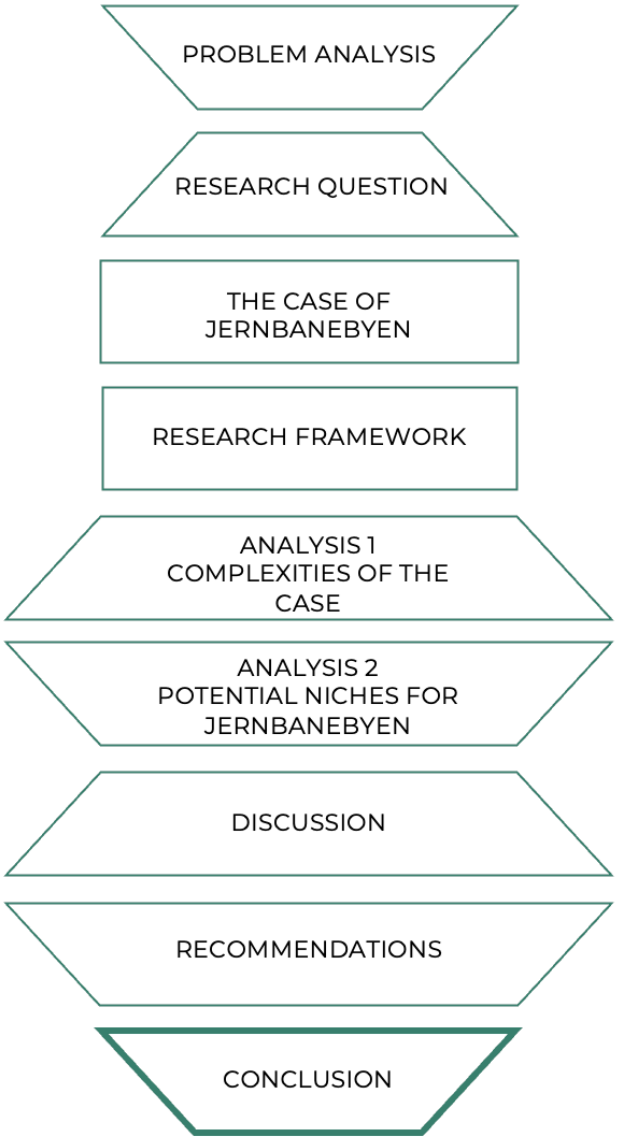
10.6 Next steps

The recommendations of this note are for the developers to implement more initiatives that enhance biodiversity. As stated in the beginning, the aim is to contribute to the developers' visions for biodiversity by providing them recommendations to further support their work.

However, the problematic biodiversity crisis cannot be solved through individual development projects and therefore, it is essential that the developers strive for interdisciplinary connections and the formation of municipal collaboration.

Jernbanebyen has a vast data collection, a special location and connection to the railroad network, if the developers take the lead and become spearhead by ensuring high quantity and quality of biodiversity on their own land with suitable habitats and ecosystems. The developers can ensure an already adapted district, which can support the municipalities' plans for biodiversity when these hopefully come into place and thereby ensuring the status as lighthouse for biodiversity in Copenhagen.

11CONCLUSION



Our thesis has examined integration of biodiversity in future planning of brownfields. Brownfields are linked to the city, have served their original purpose, and therefore have potential for new development as well as creation of new habitats and ecosystems. Green elements have become a trend in urban development, but measures for biodiversity is not supported through legal requirements such as zoning laws.

The thesis' research strategy has been supported by a pragmatic approach, combined with applied research for a case study and theoretical framework of multi-level perspective to investigate our case, find transition opportunities and explore the current urban development project of Jernbanebyen in Copenhagen.

Jernbanebyen's vision equates sustainability and 'the green city' – through the green weave as its anchor and thus, green elements and the developers' understanding of the area's natural history, defines their version of what a sustainable city should entail. In addition, the developers consequently see biodiversity as an element worthy of preservation to the same extent as the cultural buildings in the area.

In exploring how Jernbanebyen can contribute to future integration of biodiversity we stress that the developers have the opportunity to perform sociotechnical experiments with measures enhancing biodiversity. Our proposals for the developers and for the site include a market dialogue where biodiversity is central in the tender dossiers, for instance by ensuring openings in building facades for nesting birds. Additionally, to battle light pollution

experts in smart lightning need to be included in the development process to ensure both safety for humans and consideration for sensitive species.

In the future, the developers must involve the citizens in the biodiversity aspect of the site, via engaging activities such as a designated 'nature-route' through Jernbanebyen in order to obtain a new understanding of what nature is. This will ensure a stronger relation to flora and fauna, which over time will result in biodiversity being valued to a greater extent.

The recommendations of this thesis must be implemented by the developers, and we emphasize the importance of dialogue with the Municipality of Copenhagen. We encourage the developers to affect the municipal agenda and influence the creation of Biodiversity Councils resulting in collaboration across municipal borders. This will both support biodiversity and introduce rethinking of land usage in Denmark, resulting in contaminated agricultural land being cleared and thus, both be implemented in urban development and ensure that areas outside the cities can contain untouched nature that can contribute to biodiversity.

We further advice that the developers strive to integrate biodiversity in Jernbanebyen by achieving DGNB Planet. This is so that the developers can demonstrate how local measures in one place can support biodiversity and thus, indirectly influence the municipality to take further measures for the city as well as inspire other developers to take action.

In the future, we see that the EU Taxonomy will oblige the developers to adopt a more comprehensive stance in favor of biodiversity. We therefore advise the developers of Jernbanebyen to be courageous and embrace responsibility for conducting experiments and acquiring knowledge that can be shared for the city's future development. We further see that what is needed for a paradigm shift in favor of biodiversity in urban development is the dominant actors in the regime's ability to support local initiatives in developing projects in a comprehensive manner that integrate biodiversity from the start equal with other sustainable measures.

Finally, we believe that Jernbanebyen can serve as a model, if the developers adopt our recommendations, works towards altering the regime and maintain their commitment to biodiversity while developing the site. They are responsible to ensure that the economic interests do not neglect the development of the green elements. If they manage to do this, Jernbanebyen can be the indication of an emerging paradigm shift and be a beacon on how to develop brownfields in the future where biodiversity is a main priority.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12 APPENDICIES OVERVIEW

Appendix A	-	Interviews
Appendix B	-	Transcription of MortenDAC Paneldebat
Appendix C	-	Zoning law description examples
Appendix D	-	Mail correspondences

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