ARCADIA

Transformative climate resilience by nature-based solutions in the continental bio-geographical region

Work Package 5
Model region Funen (DK)

D5.1
Regional transformational goals and targets for NbS leveraged transformation to resilience. Region Funen (DK)

Co-funded by the European Union

The transformative climate resilience by nature-based solutions in the continental bio-geographical region project has received funding from the European Union under the HORIZON-MISS-2022-CLIMA-01 call with Grant Agreement n. 101112737.

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Work Package 5
Model Region Funen
DELIVERABLE NUMBER 5.1

Regional transformational goals and targets for NbS leveraged transformation to resilience

TYPE: REPORT
LEVEL OF DISSEMINATION: PUBLIC
DUE at MONTH: 12

DATE of RELEASE: 19/12/2024

RESPONSIBLE PARTNER: 30 OM

Version: 3.0

CONTRIBUTORS:
34 RSD 31 VCS, 32 SDU, 33 OFD

Co-funded by the European Union

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Project acronym	ARCADIA
Project full title	TrAnsformative climate ResilienCe by nAture-baseD solutions in the contInentAl bio-geographical region
Call identifier	Horizon-MISS-CLIMA-01
Type of action	Horizon - IA
Start date	1° January 2024
End date	
Grant Agreement n.	101112737

TABLE OF CHANGES

Version	Date	Description	Reference person	Notes
1	10-07-2024		Anna Bonven	
2	17- 11 2024	Draft for feedback	Mette Bang	
3	19-12 2024	Final version	Mette bang	

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ACRONYMS

Abbreviated	Extended
NbS	Nature-based solutions
GBI	Green Blue Initiatives
CCA	Climate change adaptation
SDU	Syddansk Universitet – University of Southern Denmark
VSC	Vand Center Syd – Water utlity company
OM	Odense Kommune - Odense Municipality
OFC	Odense Fjord Samarbejdet - Odense Fjord Collaboration
RS	Region Syddanmark - Region of Southern Denmark
KL	Kommunernes Landsforening - Local Government Denmark (the municiapalities organization)
OF	Odense Fjord
SUDS	Sustainable Drainage Systems
DANVA	Dansk Vand (Danish Water) interest organization for drinking water and wastewater companies. The association is financed by the members and by revenue-covered business.
DMI	Danmarks Metrologiske Institut – Denmark's Meteorological Institute.

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EXECUTIVE SUMMARY

In this Deliverable 5.1 for the Model Region Funen we aim at describing the regional transformational goals and targets for NbS leveraged transformation to resilience.
The report is divided into two parts:

- Adaptation in the Model Region Funen
- Regional Goals and targets

In the first part of the report, we will give an overview of adaptation in the Model Region Funen area. This is sought by giving an overview of the governance and climate change adaptation in the Danish context. After this a description of the climate risk assessment and adaptation planning framework follows.

The second part of the report will describe the goals and targets of the ARCADIA-project in Model Region Funen. The near and future ambitions of the project will be described, and an overview of the implemented Nature-based Solutions will assess the previous efforts of the comprehensive work with the Nature-based Solutions in the area. Because of this work there are a lot of stakeholders and local alliances to consider in relation to the project. The tables provide an overview of the most relevant.
Last, the three Co-innovations laboratories and their focus is described. The three labs will focus on bringing research and urban planning closer together. In Model Region Funen, three labs will start from 2024 to 2026 and take on an urban perspective in the first lab, the second lab will focus on multifunctional solutions in a river and fjord catchment area and the third lab will investigate the Blue-Green infrastructure network. The Co-innovation laboratories will be designed with the aim to facilitate dialogue between stakeholders and take a multifunctional and -disciplinary approach to water management and nature-based solutions. The lab location, duration and objectives are described in detail in the provided table.
There are a number of relevant stakeholders including other EU funded projects that need to be considered in relation to the three labs. Also several civil society groups, that are described in relation to the ambitions of engagement during the three labs duration.
As part of the NbS leveraged transformation to resilience the upscale towards transformative change is addressed. The Model Region Funen aims to leverage multiple opportunities to upscale the activities to impact a broader and lasting change. This by providing cross cutting collaboration, incorporation of a holistic approach to existing municipal plans and seeking to influence revisions of existing and coming policy at national level through meeting activities, policy briefs, presentations and the like. The final part of the report is a discussion of the current political situation in Denmark and the challenges and opportunities it possessed for the project.

This report is prepared by the members of the project group of Work package 5 of the project ARCADIA, that is dedicated to the actions of the project taking place in the geographical area of Model Region Funen.

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1. INTRODUCTION

The Model Region Funen partnership consists of Odense Municipality (OM) (WP5-lead), VandCenter Syd (VCS), University of Southern Denmark (SDU), the Region of Southern Denmark (RS) and the Odense Fjord Collaboration (OFC). The partnership is founded on a common ambition to promote nature-based solutions (NbS) in climate adaptation practices. As part of the project, a continued joint exchange on the challenges and ambitions of the different organisations will be a fruitful outcome to foster future collaboration. The WP5 partners hold different geographical boundaries and targets, hence an enduring activity will be to align the ambitions of the organisations within the scope of ARCADIA.

The Odense Fjord

Model Region Funen is centered around the Odense Fjord catchment area.
Odense Fjord (OF) is located on the northern coast of the island of Funen (Fyn) in Denmark. OF is about 61 km2 with an average depth of 2.2m. A deep and narrow navigation channel oriented in a north/south direction runs from the inlet of the fjord at the headland (Enebærodde) to Odense harbour in the inner-most part of the fjord. The maximal tidal amplitude is 0.5m and the average residence time of Odense River water is 17 days (Fyn County 2003). The fjord flows into Kattegat through a relatively narrow strait, known as "Gabet", in the northern part of the fjord. Funen's moraine soil is particularly suitable for growing agricultural crops. Land use in the catchment area of OF is dominated by agricultural production accounting for 68% of the catchment area. The remaining area is made up of approximately 16% urban areas and roads, 10% forest and 6% natural areas (meadows, bogs, pastures, lakes, and wetlands (§3 areas)[1]. It's near the city of Odense, the third-largest city in Denmark. The fjord connects to the Kattegat Sea, which is part of the North Sea.

The catchment area of OF is ~1095 km2, which makes up for about a third of Funen land area. Approximately 246,000 inhabitants live in the OF catchment area, of which roughly 182,000 live in Odense city, the third largest city in Denmark. The city of Odense has grown significantly since its establishment. The City design inside the old city centre and outside the city limits have significantly changed the city's space, and the city has gone from being an industrial city to a service and university city with an expected increase in population. The OF is in poor ecological condition. A Coastal Water Council Report (Kystvandrådsrapport)[2] has been formulated to gather and analyse all available data on the fjord to identify both pressure factors and possible solutions. The report shows that discharge of nutrients from the land areas close to the fjord must be significantly reduced to improve the ecological condition. At the same time, the report highlights the need to establish measures to improve the aquatic environment below the surface, such as establishing stone reefs and planting eelgrass. The Coastal Water Council was founded as one of four coastal water councils nationwide in February 2023 and has been working on its

[1] Odense Pilot River Basin, Naturstyrelsen 2007.
[2] Kystvandrådsrapport – Odense Fjord Samarbejdet

report until the end of 2023. The findings will become part of the work towards good ecological conditions in the fjord in both public and private stakeholders as well as part of the ARCADIA project and the OFC.

Additionally, around OF numerous land reclamation projects where areas have been diked and drained more than a century ago for agricultural purposes. The map below shows the many land reclaimed areas that are now diked. Because of the elevation of the areas being low and even below sea-level in some areas, the land is already very wet. With rising sea levels decisions will have to be made in the future to either reinforce the dikes to withstand the projected sea level rise of about 1 meter by 2100 to protect the agricultural land or to give the land back to the sea and fjord.
Coastal re-alignment involves deliberate breaching of older dikes to allow the coastline to migrate landward, creating new coastal ecosystems and works as a buffer zone for flooding from the fjord. Some projects of coastal re-alignment have already been done in several of the previously reclaimed areas: Gyldensteen[3], Vigelsø [4]and Seden Standby[5].

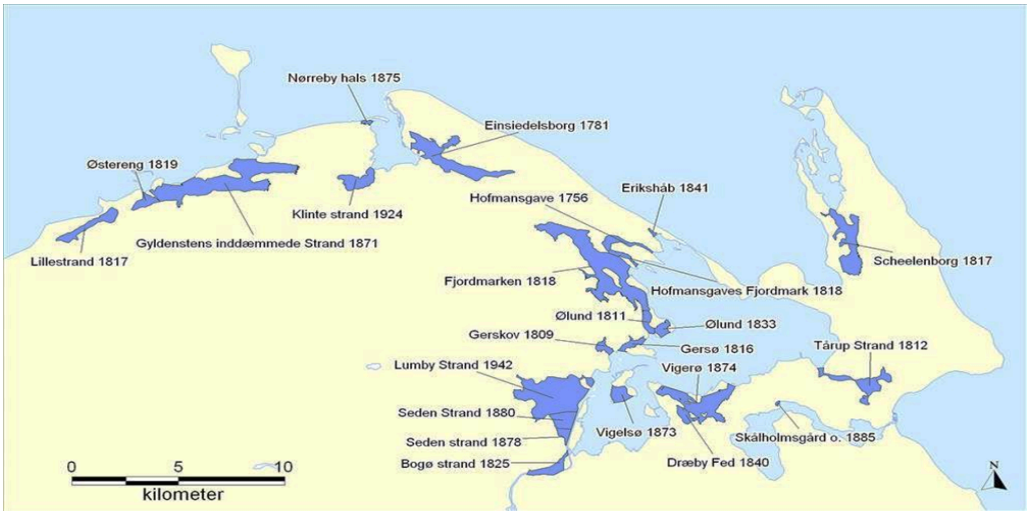

Figure 1 Land reclamations in Odense Fjord

Challenges

[3] Gyldensteen Strand is a coastal re-alignment project from 2014. The area now contains both a coastal lagune and a freshwater lake. https://www.avjf.dk/avjnf/naturomraader/gyldensteen-strand/
[4] Vigelsø is a nature restoration project creating coastal meadows in previous agricultural land. https://klimatilpasning.dk/kommuner-og-forsyning/sektorer/natur-og-miljoe/den-toerre-natur/naturgenopretning
[5] Seden strandby is a climate adaptation and nature restoration project by breaching dikes to allow the fjord the reclaim the land while making new dikes to protect the small town. https://klimatilpasning.dk/kommuner-og-forsyning/loesninger/synergiprojekter/odense-kommune-seden-strandby

The consequences of climate change are felt differently in different parts of the world. In Model Region Funen, future climate projections from General Circulation Models (GCMs) predict longer productive growing seasons and higher temperatures, and more frequent heatwaves (three days of more than 25 degrees). At the same time, the region can expect more precipitation distributed more erratically than in historical records. This means longer periods of drought followed by intense cloudbursts. In general, the region also expects more precipitation with days of more than 20 mm of rain. Projected sea-level rise reduces the resilience of the coasts, meaning fluctuations in water levels, both natural and from the projected storm surges, will be more likely to lead to flooding and create more coastal damage. Finally, on the landscape, rising shallow groundwater is becoming an increasing challenge for private owners in the city Odense because of the combination of the increasing precipitation patterns with renovation of sewage pipes, changed land use, and extensification of groundwater extraction. [6] At first sight the renovation of old pipes doesn't seem to possess a challenge, but the old pipes worked as a drainage of rising ground water and the change resulted in increased risk of flooding in inhabitants' homes due to rising groundwater levels.

2. ADAPTATION IN MODEL REGION FUNEN

2.1. Governance and Climate Change Adaptation

The following section provides a broad overview of the stakeholders and governance structure connected to climate adaptation.

Awareness and existing experiences

Odense municipal development strategy targets climate neutrality in 2030 and climate resilience in 2050. These plans aim to set a common political objective for municipal development focused on climate reduction, nature, and water management. There is a growing political interest in climate adaptation, especially in the Climate and Environmental Committee in OM, but the funds allocated to climate adaptation continue to be limited or targeted towards specific projects with a shorter timeframe. Despite climate adaptation and water management being a political priority, they often follow behind other agendas like nature and biodiversity, with climate adaptation often mentioned as an added value in nature projects. The political awareness and ambition for climate adaptation are on the rise. Furthermore, there is a growing attention towards inclusion. Meaning there is a rising attention towards combining solutions fc reducing road capacity through green and blue solutions with benefits on CO2, traffic, urban heat island effect, biodiversity and water management (Climate adaptation). As outlined above, the needs for climate adaptation are well defined, but the funding and organizational support for realization of multifunctional projects is limited.

[6] https://www.dmi.dk/fileadmin/user_upload/Rapporter/DKC/2014/Klimaforandringer_dmi.pdf
https://www.dmi.dk/klimaatlas

Over the years, a productive collaboration between stakeholders has been supported by initiatives such as the Odense Fjord Collaboration. The OFC consists of public authorities, municipalities, private companies, knowledge institutions and organizations along the fjord and spans across municipal borders that have a common ambition to set the preconditions to reach good water status in the fjord by 2027. The focus is on combining knowledge, resources and competences to accelerate action – both on land and in the water. Additionally, the University of Southern Denmark has a dedicated research effort focused on NbS in the Ecology research group in the department of Biology, as well as the SCC Elite Centre of Aquatic Nature-based Solutions. Furthermore, the local water utility company, VCS, has been working extensively with urban local water drainage and local water management on the terrain for many years which has resulted in multiple local projects in OM.

Different roles

The municipalities in Denmark serve as the planning authority and are responsible for planning urban development as well as parts of the infrastructure necessary to reduce risks of flooding within the individual municipality's borders. The Regional authority, The Region of Southern Denmark, has an unofficial role in climate adaptation. Through wide partnerships and projects, the region ensures a resilient future, where the consequences of the climate changes are dealt with. Regional role is to upscale developed solutions and to exchange the knowledge between partners to spread experience across the national and international scene.
Region Southern Denmark is playing a central role as a facilitator of the data, methods and on addressing a broader geography and longer sight of vision.

The state's role is to set the framework for legislation and management to facilitate the necessary efforts. However, a national prioritization as well as a coordinated effort across catchments and municipalities is lacking.

Decentralized responsibility

In Denmark, responsibility for climate adaptation is decentralized. This means that there is planning for climate adaptation at municipal level, but there is mostly no obligation to act. Furthermore, the foundation is incredibly mixed.
In relation to coastal protection, Odense Fjord is designated as a risk area based on the flood directive. OM is obliged to do this in terms of planning, but no duty to act has been implemented in Danish legislation. This means that OM can choose to initiate a coastal protection project on its own initiative or on behalf of an inquiry from vulnerable citizens, but we are not obliged to do so. It is the responsibility of the individual citizen to protect himself against flooding from the sea. Only the westcoast of Denmark has special status. However, there is a contingency that comes with pumps etc. However, they have limited equipment and capacity and therefore always prioritize particularly vulnerable groups first, e.g. care homes and access to hospitals and access for healthcare personnel. Life precedes

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material goods. Smaller communities at risk of flooding will therefore not experience emergency assistance.

In relation to the risk of flooding from cloudbursts or extreme rainfall over a longer period, this responsibility rests with the individual citizen. The legislation only obligates VCS to ensure a certain level based on an assessment of social appropriateness. However, this is only to the extent that these assessments have been made. The basis for these assessments has proven to be designed in a way where it rarely gives the utility the opportunity to increase service levels for more than 5- and 10-year rainfall events, which are projected in time and with a safety factor traditionally. The requirements for supply are set at the time of construction, and the sewerage system must therefore not be able to keep up with the development of the climate at all times.

In relation to increasing terrestrial groundwater, new legislation is currently under consultation which will give VCS the opportunity to handle this water. Again, from a consideration of societal expediency. The actual effect of this legislation is still uncertain. Among other things, it is planned that the supply may not enter the urban development of new areas but may only enter existing sewered areas. As the rules are today, it is the individual landowner's own responsibility to safeguard against rising ground water. A difficult task as it requires all landowners up to a usable recipient who can receive the drainage water to agree to finance construction and operation.

Climate adaptation in relation to rising temperatures is another fairly new area that the larger Danish cities (including Odense) have started to look into, but there is no legislation or government attention to the area and therefore no allocation of responsibility.

Generally, it is the individual property owner’s responsibility to protect themselves against flooding or erosion, and coastal protection must be carried out at the private owners’ own expense. There are no laws or regulations specifying whether protection is required and to what level property owners should safeguard themselves. In some cases, the municipality can decide to establish dikes and similar measures to protect against rising sea levels and determine who should bear the cost. Climate adaptation in Denmark is therefore characterized by providing solutions to a localized issue at the scale of individual homeowners or neighbourhoods, and it has not yet reached the level of collaboration across municipalities needed to address the scale of the flooding issues.

It is of course an option to take out insurance, but properties that are repeatedly exposed to damage will find that they cannot take out insurance without taking preventive measures. In addition, there is a mismatch between the fact that certain insurance policies only apply if it is established that there has been a storm surge or cloudburst. However, the number of gauges in Denmark is limited and we therefore experience that local cloudbursts cannot be documented, just as some citizens in some municipalities find it difficult to document storm surges in them, as there is no gauge locally. Furthermore, this type of insurance does not take into account that very long rains can cause flooding similar to cloudbursts.

If the state's model for societal expediency is used, then there is no financial incentive for a greater degree of protection, as the utility companies are not allowed to finance anything other than the handling of rainwater. If a broader assessment of societal costs and benefits by preventing floods is used, such as through the Damages Economy tool, this shows a different picture of profitability.

Table of main climate adaptation policy documents

The main climate adaptation policy documents in Denmark are:

	National level	Local/Municipal level	Description
EU Floods Directive	X (EU)		The Floods Directive from the EU obliges the Danish Coastal Directorate to designate the exposed places in Denmark which are at particular risk of damage in connection storm surges. These municipalities are obliged by this designation to prepare a risk management plan and through this take a position on coastal protection.
Risk Management Plan		x	The municipalities of Odense, Kerteminde and Nordfyns are together designated under the flood directive on the basis of the risk of damage from storm surges in Odense Fjord. We are obliged to draw up a risk management plan based on this and revise it every 6 years. Next time in 2026. There is currently not an overall plan for the three municipalities, which is connected to the fact that OM has also been designated on the basis of the risk of flooding up through Odense Å. Correspondingly, the other municipalities also have other challenges. However, efforts in relation to Odense Fjord are coordinated as far as possible. The challenge for implementation, however, is that projects must be paid for by civil society and often also initiated by civil society, although the municipality could take the initiative.
Planning Act	x		The Planning Act requires the municipalities in their municipal plan to map the risks of flooding from seawater, rainfall, streams and risks associated with high ground water. Furthermore, as part of the climate adaptation efforts in the municipal plan, they must create a basis for mitigation measures. The municipal plan forms the framework for local plans, which form the framework for building permits for developers.
Municipalityplan of Odense		x	OM's municipal plan explains the risk of flooding from storm surges, extreme rainfall, streams and risks associated with rising

			groundwater. As preventive measures, several guidelines ensure that future construction is not placed at a distinct risk of damage in connection with floods. The municipal plan also contains a mapping of so-called water corridors in Odense, which is a planning basis that describes where the primary flow paths are or should be. In future planning, it is therefore continuously taken into account that these road accesses are not prevented and the climate adaptation plan works to optimize their function, where this has been lost over time. Furthermore, the municipal plan sets requirements for biofactor and greening, which ensure that the risk of the urban heat island effect is reduced - while at the same time doing something good for the city's citizens and biodiversity. In the municipal plan, there is a large focus on thinking functions together, as there is often limited space in which to develop the city.
Climate Adaptation Plan 1	x		In 2023 the government presented their Climate Adaptation Plan 1. This is not a planning tool but an overview of the economy that the Danish state has dedicated to climate adaptation in the period 2024-2027. Large funds are specifically set aside to protect the west coast of Jutland against storm surges. It is also stated, among other things, that funds are set aside for a coastal pool, which the municipalities can apply for the construction of coastal protection projects around the country. In addition, future legislation is promised for the handling of rising ground water.
Climate Adaptation plan.		x	OM's current climate adaptation plan is followed by the climate action plan, which aims for Odense to be climate neutral by 2030. OM aims to be climate adapted by 2050, for which the climate adaptation plan sets out 30 initiatives - including 9 physical initiatives. However, stating that these are only the first and of highest priority and that more physical projects will follow in the ongoing revisions if Odense is to be climate-adapted in 2050. OM, together with almost all other Danish municipalities, chose to undertake the DK2020 project to prepare climate planning according to the C40 certification requirements. The Climate Adaptation Plan

			2023 is therefore certified[7]. The current Climate Adaptation Plan 2024 is a revision of the certified plan, which, in addition to the risk of flooding, also takes a greater position on the urban heat island effect.

Table 1 overview climate policy documents

Policy and barriers

The main challenge in NbS as a climate adaptation is sectoral public administration and policy while the approach must be holistic and reach across the sector barriers. Water management is divided between wastewater, groundwater, surface water, and coastal systems. This hinders the identification of synergies across the water cycle and creates a structural barrier for working with a holistic approach to NbS, where optimal requires working from the catchment area to the coasts.

Currently there is no planning framework available for climate adaptation at the national level in Denmark. This results in a lack of concentrated efforts and hence, a fragmented response and ambiguous responsibility between stakeholders. The municipalities often plan and implement climate change adaptation (CCA) measures on a local scale with no or limited coordination across shared water bodies. A solution could be an agreement on who should be responsible for financing risk reduction measures related to climate change. Private citizens and landowners express the need for the municipality to act on issues that cut across property borders, as it traditionally is regarding many issues in Denmark. The legal status now places the responsibility on the house-/landowners to invest in coastal protection measures. Meanwhile, municipalities may struggle to motivate expensive investments in risk reductive measures, which are typically financed locally rather than nationally.

Only a few pieces of legislation, such as the Coastal Protection Act, the Water Supply Act and the Executive Order on Costs, have elements that the partners of Model Region Funen identify as promoting nature-based solutions. These include rules on selecting both NbS in addition to the traditional “grey” solutions as part of water management projects, shifting the focus away from isolated measures to establishing solutions in collaboration as well as incorporating multiple functions beyond water management. The main challenges and barriers for climate adaptation in Model Region Funen are:

- Legislation does not promote multifunctionality or the collaboration of municipality, utility and civil society towards a common solution. There are both massive documentation requirements and efficiency requirements aimed at the supply, which

[7] Climate Adaptation Plan 2023 is certified after the Climate Action Planning Framework (CAPF). CAPF is a comprehensive framework for the planning of local climate actions, developed by C40. C40 is an international collaboration between several of the world's largest cities that will contribute to reducing CO2 emissions globally and countering climate change. Action plans are therefore compatible with the Paris Agreement.

must ensure that they will not have to pay for anything other than the water management itself. This can place limitations on the nature-based solutions, as complicated ownership relationships can create too much uncertainty.
- Limited funding possibilities are available, and municipalities are in competition with each other to receive national funding for projects. The existing funding measures are highly sectoral and do not promote multifunctionality.
- The mitigation agenda is politically emphasized at the expense of adaptation.

2.2 Climate Risk Assessment Status

The following section provides a broad overview of the approach to risk assessment currently implemented in Model Region Funen, specifically from OM.

In Denmark, climate adaptation has so far primarily focused on water management for flooding as Denmark has an existing abundance of water, which will be exacerbated with the additional projected precipitation. Climate adaptation in the municipalities is then primarily focused on managing increasing amounts of water. In the case of OM, the risks are specifically related to flooding caused by rising groundwater and storm surge. Additionally, rising temperatures and droughts can alter the extent of flooding events, and hence have also become a focus of climate adaptation in recent years.

More heat and water from every direction
All over the world we experience climate change, but what we each experience depends on where we are. Here in Odense in Denmark we partly get higher temperatures, but also quite a bit more water.

We are talking about the water coming from all sides. From above we get more precipitation. Groundwater rises from below. From behind, the water comes from the catchment and down through our streams and in front of us we look out into the Odense Fjord, where the surface water disappears, but where seawater also comes in as a result of rising sea levels and not least in connection with storm surges.

The drawing below illustrates this.

Figure 2 illustration of water

Flooding by storm surge

In Denmark, we expect an increase in sea water of 30 cm towards the year 2050 and approx. 60 cm towards the year 2100, cf. latest data from DMI, while the UN's 6th main report said 100 cm in 2022. However, we also expect that the water level will continue to rise thereafter.

These increases do not in themselves constitute a major problem, but they mean another starting point for the variations that occur throughout the year. And this is becoming more and more pronounced. A daily water level variation of 30 cm is normal today. And during the year, variations of 80 cm are very normal. A storm surge today is 150-180 cm and we are prepared for that. But in the future these events could be 250 cm or higher and we are not yet prepared for that.

There is great uncertainty about data from storm surges, partly because the amount of data we have is very limited. There is therefore a high probability that we will experience more high water and storm surge events than what the statistics show. In the past 20 years, we have had quite a few more 15–20-year incidents than what should statistically be possible. Another major uncertainty is the many models and, not least, their interpretation depending on the trust in the initiatives that have been launched globally to reduce emissions.

There are three gauges in Odense Fjord, which continuously measure the water level in the fjord. However, the two in the inner parts of the fjord are relatively new and there is

therefore a limited timeline for these. It is inappropriate, as we can see that there is a certain back-up in the river of up to 20-30 cm compared to measurements in the mouth to the north. At this mouth sits the third gauge, which has a longer history. However, there are also gaps in our time series, as there have been problems with meters falling off during high tides. We have therefore looked into statistics from Hornbæk to model better data for Odense Fjord. [8]

The map below shows the spread of a high-water event of 250 cm, which is the event that we are currently planning to climate-adapt Odense to.

Figure 3 Flooding by storm surge

Flooding from cloudburst and longtime raining

Already now we experience that more rain is coming, and all statistics say that this trend will continue. It is not just that the amount of rain will increase; we are going to get both more very heavy downpours and longer periods of rain. The quantity will increase both in spring and autumn. Short-term cloudbursts are most often expected to occur in the summer.

Both VSC and DMI measure rainfall amounts. However, the number of meters is limited, and we therefore do not always have data for cloudbursts, which can be very local.

[8] Højvandsstatistik for Odense Kommune, 7. marts 2024 af Niras

The map below shows a modelling on a glass surface. That is, a map of Odense and where the water will collect in depressions if there was a rainfall event of 90 mm, and the ground was already waterlogged. In our planning, we try to avoid building inappropriately in these areas.

Going forward, however, it will not be at this level that we try to adapt Odense to the climate, as Danish legislation sets the stage for such ambitions that are not deemed socially appropriate based, among other things, on a narrow socio-economic assessment. However, we will continue to try to use this 100-year incident on 90mm as a common-sense starting point. However, the technical mitigation solutions and nature-based solutions to adapt the city to the climate will probably only be able to be dimensioned to 5-10. year's rainfall events plus a safety factor that ensures a certain projection in relation to changes in climate, the densification of the city and general uncertainty.

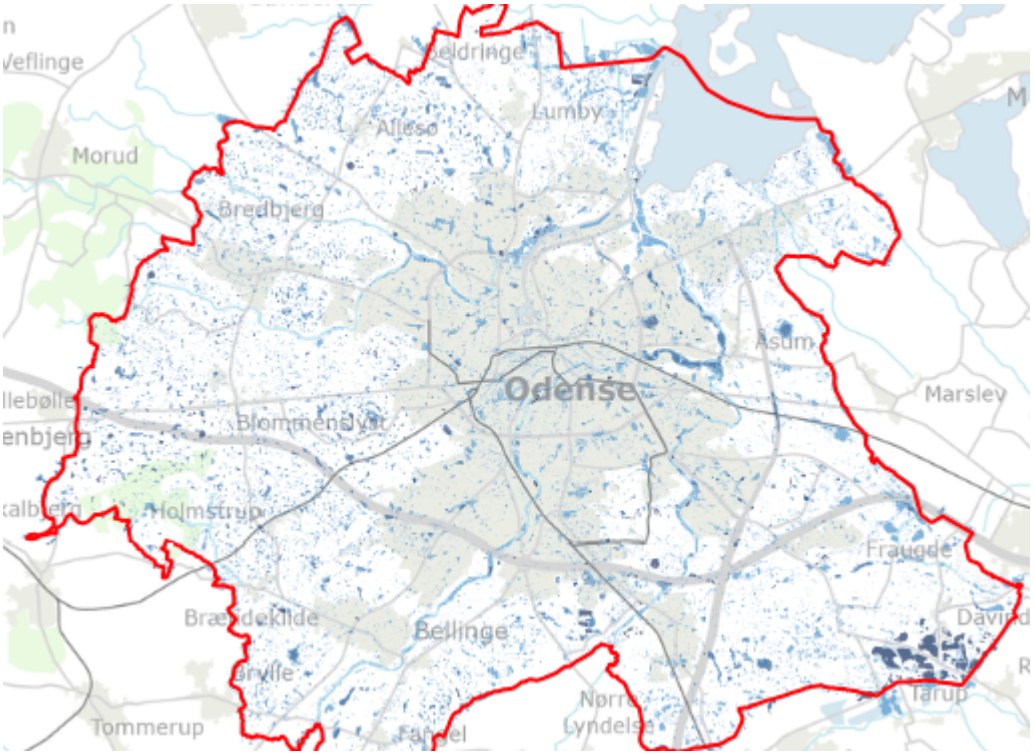

Figure 4 modelling of Odense

Flooding by streams

Increased rainfall and higher water levels in the sea and not least in the Odense Fjord mean that the streams around Odense will also receive much more water - and we will increasingly see floods along these streams. The map below shows the expected extent of flooding around the municipality's largest watercourse. The areas here are predominantly laid out for recreational purposes and the floods therefore have limited significance, apart from the fact

that some cycle paths, exercise areas and playgrounds are periodically flooded with the need for clean-up and repairs which this now entails. This is a limited cost.

However, what is also worth noting in this context is that there is a part of our watercourses which today is piped and there are also a few watercourses from olden times which have disappeared over the years and where houses have been built today. Especially in these areas, we see increasing problems with flooding of people's gardens, basements and sometimes living areas as well, which during particularly rainy periods can cause damage to property. Over time, it is desired to reopen more streams and not least to restore lost streams so that the natural hydrology can be restored, and Odense can thus become more resilient to longer periods of rainfall. This is described in the Climate Adaptation Plan.

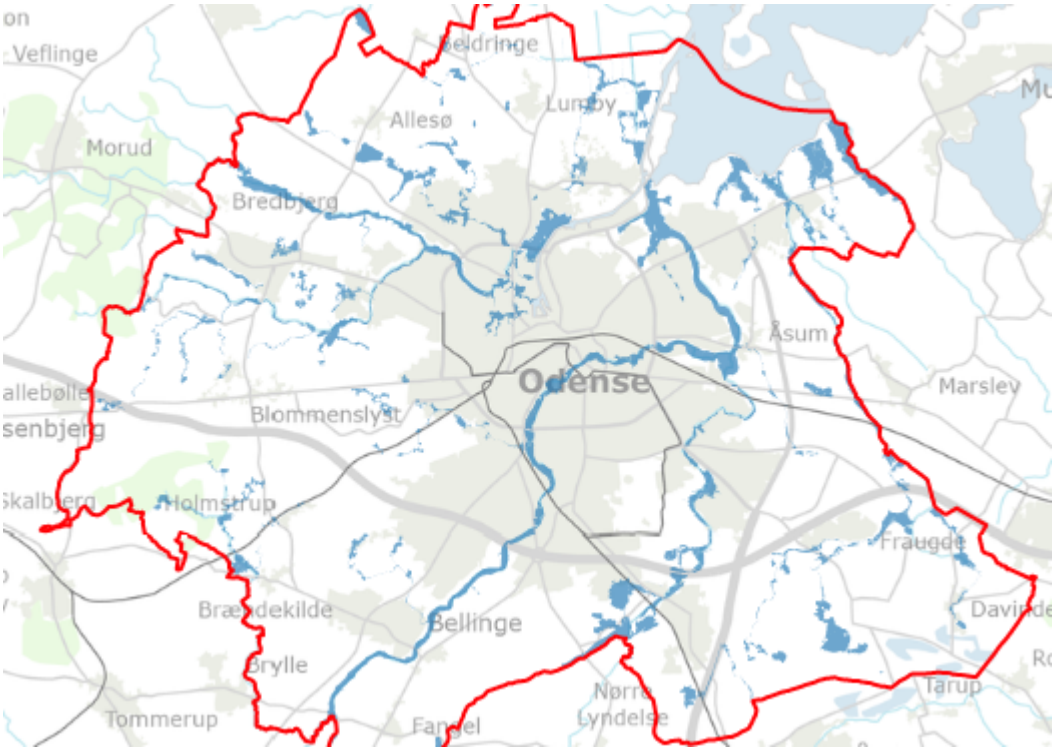

Figure 5 expected extent of flooding

Rising groundwater

Increased rainfall in large parts of Odense also results in a rising level of groundwater. We can see how it has largely increased over the past 30 years, and we expect this to continue.

There are sporadic measurements, e.g. in connection with water supply boreholes and new construction but monitoring of this development is primarily based on model work.
The map below shows in blue the areas where groundwater is likely to be less than 2 meters from the ground over the coming years.

We try to take this into account in our planning for the development of the city and new residential areas, but it is also a development where Danish legislation has not kept up. The options for handling other than banning construction are therefore limited. In a growing city, the ground water close to the ground and the risk of a damp garden and wet basement are not a sufficient reason to avoid construction. The task therefore most often ends with the individual landowner.

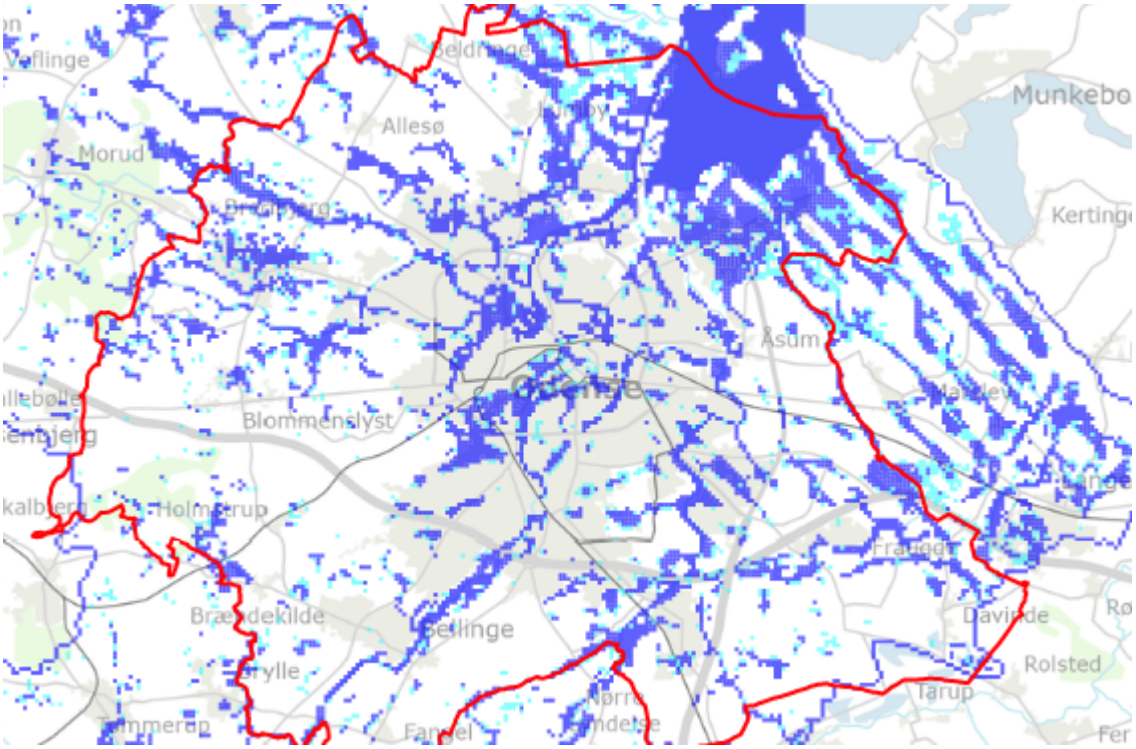

Figure 6 groundwater modelling

Urban Heat Island

It is relatively new, but we have increasingly become aware that the rising temperatures and the risk of Urban Heat Island is something that we must decide on in Odense.

The map below shows the areas in Odense where the surface temperature is significantly higher than in the rest of the city. This is based on Landsat 8 data and materials on the surface have been considered. This is our first measurement and how often we will make these measurements is not yet completely clear but expected every 4-6. years to be able to see the difference in the city over time.

For many years, we have worked to increase the proportion of greenery in the city, and we can see on the map that the areas where efforts have been made for this have also had a positive effect. However, the maps also show that the challenge with heat is greater than we had first assumed. Among other things, it has been shown that a very large part of our care homes, schools and institutions, which are expected to be more exposed to the effects of

heat than the general population, are largely affected. This has been incorporated into the Climate Adaptation Plan 2024 as a new initiative that must be continuously monitored. All efforts in the climate adaptation plan are monitored and there is an annual political report on progress.

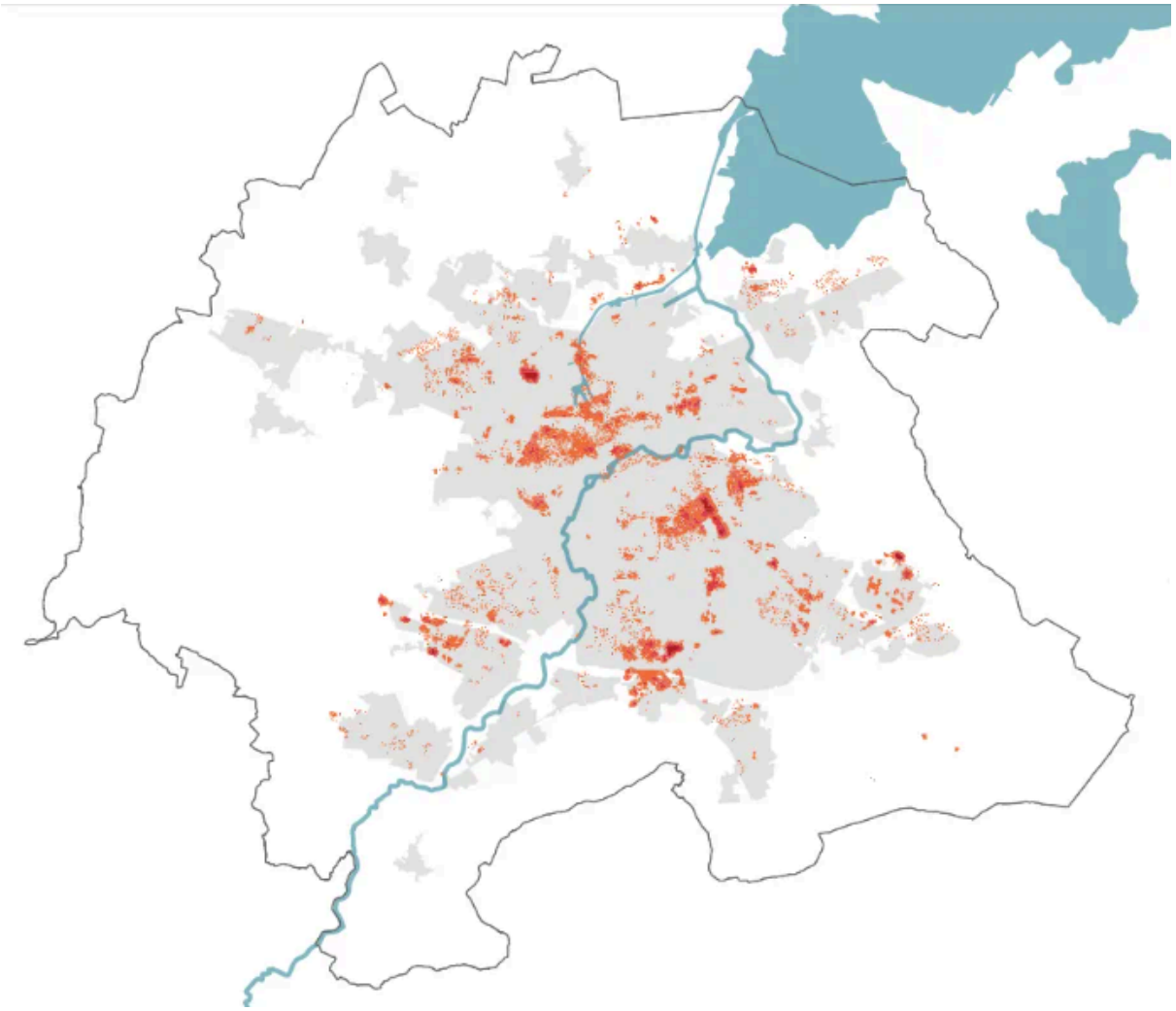

Figure 7 map of higher surface temperature in Odense

2.3 Adaptation Planning

The following section provides an overview of the political ambitions on adaptation planning and the current potentials and barriers in promoting multifunctional solutions.

Climate Action Plan

The OM Climate Action Plan[9] targets climate neutrality in 2030 and climate resilience in 2050. These aims set a common political goal for municipal development focused on

[9] Odense Kommune, Klimahandleplan 2024

climate reduction, nature, and water management. As one of the largest municipalities in Denmark, Odense aims to be able to contribute to the transformational change by incorporating adaptation planning across the OM departments with both small-scale initiatives and by strategically promoting and incorporating both blue and green initiatives in municipal workflows.

Risk Management Plan

In 2011, Odense Fjord was designated by the Ministry of Environment as a risk area in connection to the integration of the EU Floods Directive into Danish legislation. Based on a screening of Denmark, the designation of risk areas was made by the Danish Coastal Authority that assessed where values beyond 1,5 billion DKK[10] or more than 750 properties were estimated to be at risk of flooding in a 1000-year event. 10 areas in Denmark were designated back then. Today 25 risk areas are designated.
OM's area is located at risk of flooding by the Odense Fjord were designated together with the municipalities of Kerteminde and Nordfyn, which also have areas next to the fjord. A network has been established across the fjord municipalities, where it is possible to follow-up on the cross-cutting initiatives between the municipalities.

The risk management plan in OM 2021; "Udsigt til Vand"[11] was adopted by Odense City Council in October 2021. The plan is only applicable to OM and must be reviewed at least every six years. The next revision will take place before 2027. The plan includes the following seven initiatives that OM has assessed to be necessary to better safeguard the area around Odense Fjord and the Odense River:

1. West and north dike at Seden Strandby
2. Areas of Agedrup a part of Bullerup and along the way to Kerteminde which are specifically at risk of flooding at extremely high tides.
3. Flood protection of properties at Færgevej
4. Dykes at the contained area of Lumby.
5. Long-term flood protection; lock in Odense Canal
6. Flood protection via building restrictions
7. Information to citizens, crisis preparedness Funen for handling climate-related incidents such as storm surge or extreme rain and collaboration with neighbouring municipalities along the fjord.

The risk management plan affects a wide range of different stakeholders, including citizens, businesses, local pump and dike associations, VCS (water utility company), Emergency Preparedness Funen (Beredskab Fyn), Funen Police, neighbouring municipalities, the region and the state. The implementation of the risk management plan must be done in close dialogue and collaboration with the affected parties.

[10] Equivalent of approximately 201.138.750,00 EUR (converted 20241211).
[11] 20210928_Udsigt til Vand_Odense Kommune

Both the risk management plan and the Climate Adaptation Plan are monitored. The Risk Assessment Plans are monitored at a national level.

Action plan for water management

An action plan for water management (Handleplan for Vandets Kredsløb)[12] has been developed as part of ARCADIA to provide the Climate and Environment Committee in OM with a more integrated approach to water management and incorporates collaboration from stakeholders as a prerequisite for developing multifunctional solutions. Among other things, the plan proposes a multifunctional funding pool for the buying of land and properties with the goal of creating more multifunctional projects and connected areas for water management and nature. The action plan was adopted with support from all political parties in the city council in December 2024[13]. The action plan serves as a lever in creating political awareness and promoting the holistic approach and cross cutting collaboration about water management in Model Region Funen. For an overview of the plan see the annex.

Climate Adaptation Plan

In 2023 OM completed The Climate Action Planning Framework (CAPF) from the international C40 resulting in the Climate Adaptation Plan and the Climate Action Plan. In this the mapping of value-loss from flooding from present day to end-of-century (2100) is estimated to be around DKK 100 million annually (approximately 13.409.340,00 Euro) for OM[14], assuming no climate adaptation or development of the city takes place in the meantime in relation to storm surge and extreme rains. The mapping shows that the highest risks and greatest losses follow storm surges from coupled events, where extreme rainfall coincides with a storm surge from the fjord. This risk assessment points to value loss mainly in relation to damage to buildings, but several sectors are included in the considerations, including homeowners, landowners and businesses, as well as health and safety of people during and after a flood. Costs associated with rehousing or longer traveling time due to flooded and damaged roads, recreational areas and habitats with protected species were similarly considered in the plan. However, the consequences of these risks have only been assessed qualitatively and are estimated to cause minor loss of value.

When revising the climate adaptation plan 2023[15] there is added a mapping of the heat signature of the city. The mapping has pointed to several heats places that give rise to more general efforts rather than more site-specific efforts. In the long run, it will be possible to select more site-specific initiatives. The heat mapping has not given reason to change the

[12] Klima- og Miljøudvalget - Referat 28. maj 2024 (odense.dk)
[13] The OM City Council both adopted the action plan for water management (vote on 11th December 2014). ARCADIA under agenda item nr. 2 "Handleplan for Vandets Kredsløb" at Odense Byråd - Byrådssalen
[14] Odense Climate Adaptation Plan 2024 Risk mapping.
[15] Climate Adaptation Plan 2024 / Klimatilpasningsplan 2024

risk mapping, then it is especially the central parts of Odense where the assessment is made risk in relation to the rising temperatures.

As described in 2.2 Climate Risk Assessment Status Odense has looked at the scenarios for climate change towards the year 2100 in all of our mapping of risks. We have also looked at up to 100 year incidents. Due to the flood directive, in relation to storm surges, we have also looked at up to 1000 year incidents.

The climate adaptation plan contains 30 efforts, which range widely from physical construction projects up to more strategic efforts.[16]
The efforts are divided into six main topics:

1. Urban development with quality, which is about planning and the democratic conversation with the public.
2. A greener Odense, which is about increasing the number of trees in the city, reopening and restoring more watercourses, as well as working for the greening of especially our nursing homes, institutions and schools, which are assessed to be particularly affected by the rising temperatures.
3. Coastal protection, which is partly about the need to draw up a comprehensive plan for the protection of the Odense Indre Fjord. Including a clarification of when our adaptive approach entails a need to switch from a more local solution to a regional solution. In part, this subject contains physical efforts in accordance with the risk management plan drawn up under the flood directive.
4. Water management contains the highest priority nine efforts to restore water corridors in Odense. This is a theme where new physical projects will continuously be added when the plan is revised.
5. Named Odense Municipality and contains the measures in which OM, as an authority and landowner, can make an effort itself. Including what we aim for in connection with our own buildings and areas, and not least our monitoring.
6. Partnerships include the more cross-cutting efforts. Including collaboration with Beredskab Fyn, VCS, the public housing companies, neighboring municipalities and a general work for partnership models, which could for example be with the private business community.

The monitoring of the Climate Adaptation Plans is located at the municipal level.

Potential barriers /Challenges

A potential barrier can be that funding for adaptation projects is limited. For example, 3 million DKK[17] was allocated in 2024 for a climate adaptation project proposed in the OM Climate Adaptation Plan 2023, at Bolbro Rende[18]. The initial estimated budget for the project was 8,5 milion DKK. so, the scale of the project had to be adjusted. The project includes a water corridor that will transport surface water from one area of Odense (Bolbro)

[16] Climate Adaptation Plan 2024 / Klimatilpasningsplan 2024
[17] Approximately 402.276,90 EUR (converted 20241211).
[18] Klimatilpasningsplan 2023 (odense.dk), p. 38-39

to Odense Harbour while improving the conditions for biodiversity and water quality. The project is currently being planned to follow the reduced budget. One way to overcome this barrier is to promote multifunctionality in projects and use allocated funds for what would traditionally be used for singular objectives for a project (fx, biodiversity, water management, recreation) for a single project.

Another barrier can be the fact that Odense is a city surrounded by large suburban areas with one-family houses, roads, and hard surfaces. With the estimated growth of the city, urban development is expected to reach municipal borders in 2050[19]. The space for water management, nature, biodiversity, and many other objectives is highly limited and there is an acknowledged need for a multifunctional approach to lift the ambitions of the multiple political agendas. The agenda of climate adaptation planning is in constant competition with other political agendas, for example the ambition to develop the city to meet the requirements of a growing population and attract new industry. A more holistic and collaborative approach could help to overcome this barrier. The use of NbS can be a way to manage challenges by incorporating more values and tackling water management issues in synergy with "blue and green solutions" rather than in costly and inflexible pipes and "grey solutions" and add value to multiple bottom lines through multifunctional projects, in addition, green solutions often have a much lower climate/carbon footprint than traditional underground gray solutions.

The structure of the resort areas of the OM departments can also constitute a barrier for adaptation planning. Cross-sectoral planning is limited and continues to be influenced by silos between technical teams and management areas[20] within the OM. The importance and ambition to have a cross-cutting approach to climate, nature and environment through partnerships and multifunctional initiatives is repeated[21] and promoted in the action plan of the water cycle. However, in practice it is an ongoing challenge to balance interests across management areas and financial allocation for projects, to secure collaboration between stakeholders and end up with the best solution for all involved. There are good initiatives that promote collaboration and incorporate adaptation planning initiatives in relation to for example city development.

For the time being the city of Odense has only experienced a few extreme events that have resulted in the natural political focus and an immediate need to allocate financing for larger adaptation projects. Therefore, the climate and environmental agenda can be said to compete with other urgent political agendas such as increasing expenses for healthcare due to an increase in elderly citizens etc. The need for continuous collaboration and alignment between departments is a prerequisite for a fruitful collaboration across the various stakeholders.

[19] Odense Kommune - Byudvikling
[20] Mandag Morgen. Danmarks miljø afhænger af 39 love, der kan spænde ben for hinanden. 15. juni 2024.
[21]

While multifunctionality is becoming a key word in urban planning and nature and climate management, existing structural divides between organizational units and funding programmes limit the implementation of synergies in projects. Organizational silos between technical teams and management areas continue to characterize a fractioned approach despite political ambition and planning. Furthermore, there is a need to streamline the sectoral legislation related to water management, as many areas of authority and grant opportunities are not synchronized and often limit the implementation of the other.

3. REGIONAL GOALS AND TARGETS

3.1 Vision in the Region

Climate Adaptation Plan

The OM Climate Adaptation Plan 2024[22] sets the ambitions for the initiatives in Odense to create a robust and resilient metropole. OM is the largest city on the island of Funen and is situated at the outlet of the Odense River from which 1/3 of the water from Funen drains through. OM shares the catchment to the fjord with Nordfyn, Faaborg-Midtfyn and Kerteminde municipalities.

The Climate Adaptation Plan sets the vision for a climate-adapted city of Odense in 2050 and onwards. The initiatives set targets to be developed with multifunctional purposes and creating synergies for biodiversity, nature and community as a continued foundation in the plan. NbS are mentioned explicitly in projects related to nature restoration and generally as an element to consider in all projects to support the interaction with nature. The table below illustrates the phases of the visioned implementation of climate adaptation in OM.

[22] Klimatilpasningsplan 2023 (odense.dk)

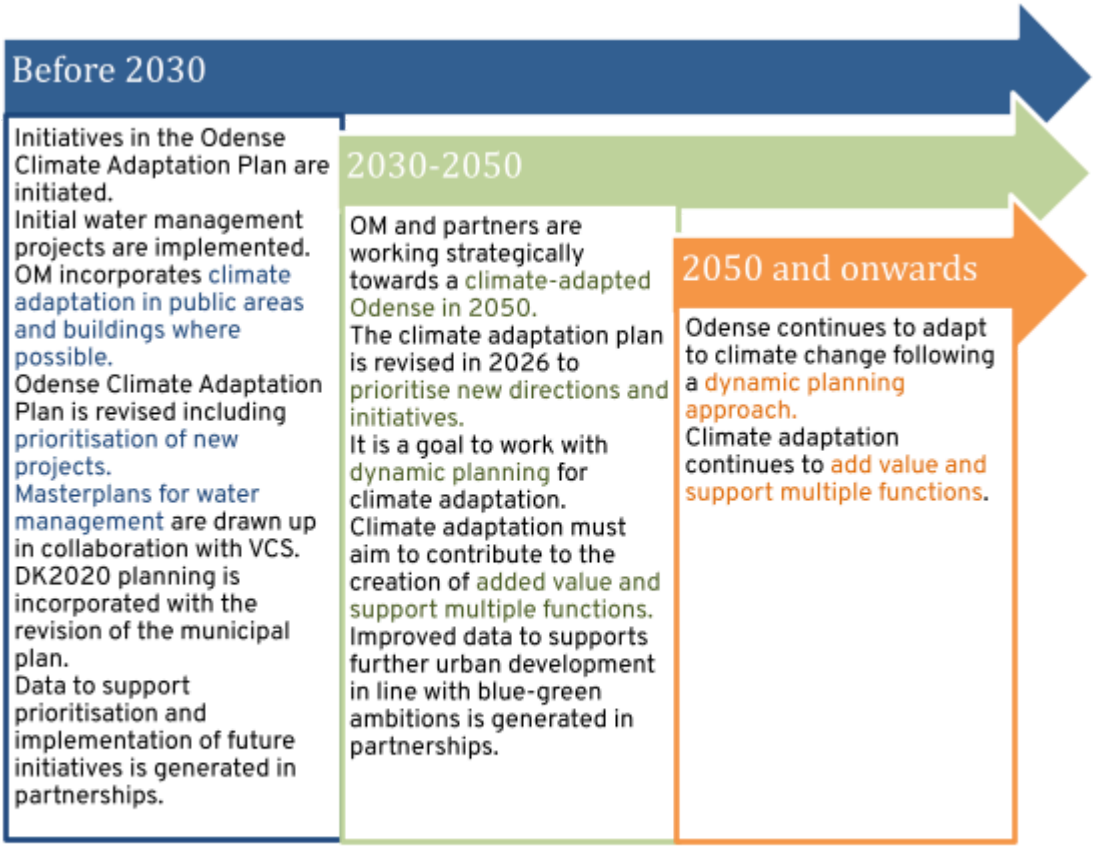

Figure 8 Illustration of goals and phases in the OM Climate Adaptation Plan 2023.

The Climate Adaptation Plan includes potential climate adaptation projects prioritized according to the risk assessment, as seen in figure 1 in the previous chapter, where the main hotspots deemed necessary to handle were identified. The map includes numbers for projects included in the Climate Adaptation Plan. OM's Climate Adaptation Plan lists a set of principles that climate adaptation in the municipality should comply with. The principles include among others a greener city with more trees and shadow and less traffic, room for water corridors and water retainment through seepage, evaporation and on surface level.

Climate Adaptation planning in Odense strives to create sustainable solutions and each project in OM's Climate Adaptation Plan is scored in five parameters of potential added value: Biodiversity, community, health, traffic safety, water environment, multi-functionality. Through these principles and potential added values OM ensures that climate adaptation projects are multi-functional and beneficial for nature, society and the climate.

In combination with the OM adaptation plan the Climate Action Plan 2023[23] mentions climate adaptation as an element to be considered in relation to other climate mitigation measures such as afforestation, rewetting of low-lying areas and peatlands, and sustainable urban development and construction.

Odense Fjord Collaborations Vision

The OFC was founded in 2021 and is currently revisiting its vision together with its partners. The foundation, however, remains: What started as a bottom-up initiative by a local agricultural organisation, the largest Danish nature conservation NGO (Danmarks Naturfredningsforening) and other relevant stakeholders, is now a strong partnership between 17 local partners around the Odense Fjord. During the first years, focus has primarily been on accumulating existing and new data to gain a holistic definition of the issues at hand.

In the new vision statement, primary focus is set on *action*. Nature-based solutions are mentioned explicitly as a relevant tool on land, alongside marine restoration in the fjord. *Inspiration* and *knowledge* are the other main pillars of OFC's new vision. For a detailed description on the vision see the annex.

OFC is always searching to create connections between its partners to widen their scope towards holistic solutions, e.g. when it comes to the four municipalities that are connected to the fjord. With increased focus on water quality and climate adaptation also on a national scale, OFC will continue to play a facilitating role e.g. in the next generation of local Coastal Water Councils (Kystvandråd) and coordinate projects with the new catchment area steering council – cooperations (vandoplandsstyregruppe (VOS)-samarbejder).

3.2 Near and Future Ambitions

The partners of Model Region Funen aim to promote NbS/GBI as a driver for climate adaptation with the potential to manage multiple challenges with solutions that also supports biodiversity and quality of life for humans. Working with NbS/GBI, the Model Region Funen partnership is inspired by natural dynamics in technical water management solutions supporting multiple functions, including urban greening, biodiversity and social/recreational wellbeing.

Being part of an innovation and research project, Model Region Funen aims to raise the level of data on NbS/GBI to promote a stronger implementation of NbS/GBI. Better data can provide both politicians and managers with a better understanding of NbS/GBI and their potentials and help promote a solid foundation of knowledge when they discuss adaptation plans, allocation of funding and incorporate NbS/GBI in projects that will turn ambitions to action.

[23] Klimahandleplan 2023 (odense.dk)

In the first Co-innovation lab, we want to make a comprehensive assessment of a selected urban area's possibilities within hydrology, nature and quality of life as a basis for describing synergies and creating a clear picture of a project that can promote fundraising and political decision-making. This work will form the basis for the next two labs in a three-step process that focuses on sustainable urban drainage systems with nature-based solutions.

Part of the innovation consists of facilitating collaboration between the project partners and the stakeholders. To establish new ways to have continuous fruitful dialogues about NbS and GBI we need to practice this collaboration within the project partners. The Model Region Funen's ambition is to use this project as a driver of transformation in the region by developing and practising this approach. The collaboration will challenge the traditional organizational silo-thinking and promote re-structuring and path-shifting towards commitment to working towards a common goal or cause.
The Model Region Funen also has an ambition to organize consultations with regional/local authorities, alliances & partnerships, to collect views, perspectives and suggestions from across communities and regional societies.

In the section below, the ambitions of Model Region Funen are described on a local, regional and national scale:

Model Region Funen ambition
For the Model Region Funen partners, the ambition for nature-based solutions (NbS) is to create solutions that are inspired and supported by nature to provide values for both people and nature. This means a systemic approach that mimics natural processes. The approach to climate adaptation solutions must be multifunctional as both funding and space is limited. Multifunctional purposes of NbS include, but are not limited to, water management, recreation, reduction of heat issues and biodiversity support.

As a basis for working with NbS, there is a need to look at larger systems and across sectoral divides to enable the best solutions. In Model Region Funen, this especially points to the connections in the water cycle from the upland to the fjord where multiple synergies can be developed and exploited further. This approach requires the need for close collaboration between stakeholders within the catchment to align strategies and actions.

On local scale
The OM has adopted the action plan for water management. The action plan will serve as the basis for supporting a political process towards a holistic approach to nature, environment and climate adaptation. The action plan is to be used as a framework for political commitment and works as leverage of the agenda as the committee is set to get an annual status on the progress of selected indicators. With the initiatives described in the action plan, collaboration and partnership between stakeholders, across sectors and organisations is needed to design and implement multifunctional nature-based solutions. The ambition is to create strategic favourable conditions to turn political ambition into

concrete funding for projects that promote awareness of the potentials of NbS and the wider adoption of NbS in the municipal planning and workflows.

Model Region Funen, and especially the partners OM and the water utility company VCS will work towards the integration of nature-based solutions in the revisions of future municipal plans. To anchor the strategic planning methods in the administration, the project is working to provide input on climate adaptation themes for the OM's various sector plans, including:

- Politically adopt Action plan for Water Management in 2024 and give a status on progress of the indicators/review the plan continuously.
- Revision of Odense Wastewater Plan and Odense Municipal Plan in 2025
- Revision of Odense Climate Adaptation Plan in 2026
- Revision of Odense Risk Management Plan in 2027 in dialogue with neighbouring municipalities.

On regional scale

The task to formulate a Vision for the Odense Fjord Collaboration will support a process towards closer collaboration between the engaged partners to reaffirm the shared goal and ARCADIA in Model Region Funen will target:

- That the strategic vision includes mutually decided goals for the use of nature-based solutions in the future management of Odense Fjord and upland.
- That the importance of cross-cutting collaboration and a catchment-based perspective on the interconnected challenges to improve the condition of the fjord is linked to climate adaptation and water management initiatives on a broad scale.

To disseminate findings and results, the partners in Model Region Funen will promote awareness raising and knowledge exchange through the regional facilitated Climate Alliance by participating in regional peer groups on climate adaptation for the municipalities across Denmark. The peer groups will be presented with the goals and focus of the work carried out in Model Region Funen and the project can disseminate project results while gaining input by inviting the municipal stakeholders to share their own lessons learned. In addition to this the Model Region Funen can promote results and participate in local events co-organized by RS as for example the Klimafolkemødet (citizens/NGOs) and the Klimatopmødet in the city of Thy (researchers/professionals). Furthermore, it is the intention to share the holistic approach used in Model Region Funen between other projects RS participates in.

As part of the General Assembly and festival organised by the partners in Model Region Funen in 2025/26, the goal is to mobilise key stakeholders with top knowledge on nature-based solutions and integrated water management to provide participants with insights and learnings on innovative and practical solutions. The Model Region Funen steering committee commits to participating in contributing with their expertise to the festival and in general to bring results from the project into discussions and dialogues where they partake.

On national scale

The ambition of the Model Region is to promote knowledge and awareness of NbS/GBI and promote best practice in holistic approaches and collaboration. The managers in the Steering Committee and the project group have committed to bring their knowledge from the project into the political and administrative circles they engage with. In combination with political awareness supplied with a solid data foundation the ambition is to act and commit to funding of climate adaptation projects which include NbS.

An example of leveraging the knowledge is the OM and the utility company VCS have been invited to take part in workshops organised by KL and DANVA to develop a catalogue of measures to deal with the shallow groundwater to influence upcoming legislation. In the end of November 2024, the inspirational catalogue[24] about handling groundwater close to the ground in cities was released from the Water sector. It lobbies for less bureaucracy, less silo-thinking and a collaborative approach to the management of the shallow groundwater. The goal is for the collaboration and results produced in Model Region Funen will feed into this work. The partnership aims to promote the following elements to be part of future legislation:

- New type of supply in the Wastewater Act and the Water Sector Act including groundwater sewage system in vulnerable areas
- The possibility to source and avoid the consequences of new and sealed pipes, e.g. in connection with the implementation of separate sewage systems.
- More autonomy in stormwater and groundwater management, e.g. combined SUDS and drainage solutions, and provide more flexibility in the choice of solutions, e.g. maintained water extraction, recreation of watercourses as technical facilities, drainage systems, etc.
- Better opportunities to utilize the water, e.g. in energy production, reclaimed water, etc.
- The water authority must be able to issue orders to seal pipe connections and hold the resources for enforcement
- Lastly, the legislation should enable holistic water management across current administrative boundaries for the water cycle in cities.

The partners in Model Region Funen, especially the utility company VCS, are contributing with their experiences and feedback in the process of adapting the Service Level Order. The aim with ARCADIA in the Model Region Funen is to be able to influence national policy following the revisions through meeting activities, presentations, articles and the like.
The aim is that the knowledge about NbS and the holistic approach to collaboration in the Model Region will provide examples of best practice that will draw attention to the climate resilience agenda, provide funding for acting and inspire on a national scale.

24 https://www.danva.dk/viden/terraennaert-grundvand/inspirationskatalog-for-haandtering-af-terraennaert-grundvand-i-byer/

The Near and future ambitions of Model Region Fyn therefore are to contribute to a higher level of governance for politicians and managers. The ambition is to raise awareness and data on NbS/GBI qualities and potentials and contribute to the transformational change by practicing collaboration and having consultations with representatives across communities and regional societies.

3.3 Inventory of previously implemented NbS

The following table is an inventory of a selection of the previously implemented NbS:

Implemented NbS measures in the region	**Location example**	**Description**
Wet stormwater pond (vådt regnvandsbassin)	Storm water ponds at the urban area of Ejersmindevej and Mågebakken in Odense. Three small ponds were established in a residential area which has previously been plagued by floodings at heavy rainfalls. The three ponds have a total capacity of 10.000 m3 and the ponds also function as green recreational areas for the neighborhood's residents. There are several examples of these ponds. The award-winning project at Glisholm Sø is another.	Wet stormwater ponds or basins can vary a lot in design, but the overall function is the same: retention AND treatment. Stormwater retention ponds are ponds, pools or small lakes designed with additional storage capacity on top of the water table to reduce the hydraulic load surface runoff during rainfall events. The wet ponds consist of a permanent pond area with landscaped banks and surroundings to provide storage capacity for stormwater runoff. They are created by using an existing natural depression, by excavating a new depression, or by constructing embankments.
Infiltration ponds (nedsivningsbassin)	For example, the infiltration basin is located in the park next to the bicycle arena (Odense cykelbane) and it is created to receive runoff water from the bicycle track.	Infiltration ponds are favorable where outlet to a recipient is not an option and where it is possible for the water to percolate. Infiltration ponds are designed to retain stormwater runoffs and percolate through

		the soil and the infiltration can happen in anything between hours or days and the basin is dry between rainfalls. Infiltration ponds can be an opportunity to treat the water while it percolates through the ground.
Rain gardens for infiltration and evaporation (Regnbed til nedsivning og fordampning, uden afløb)	The urban neighborhood of Skibhus.	A rain garden without an outlet is used to store, filter and treat water before the water infiltrates to the ground or evaporates from the basin. To optimize its functions, it must include a porous soil mixture called filter soil, native vegetation and hyperaccumulator plants, capable of absorbing environmentally harmful substances to ensure treatment. The plants in rain gardens should be able to cope with dry and wet conditions. A rain garden can also include a fascine underneath the filter soil where water can be collected before infiltrating to the ground.
Rain Gartens along the road (Vejbed)	Urban areas of Langelinje, several roads in the Skibus neighborhood and Middelfartvej amongst others,	Surface runoffs from roads are of poor water quality, where particles, heavy metals and other dirt is polluting the water. The pollutants are coming from tires and oils spills from cars and from roofs on buildings that likewise emit particles and dirt. Rain gardens can therefore be effective for treating the polluted runoff water from the

		roads through filter soil specific for filtering oil spills and heavy metals from the water. The rain gardens can be established with or without an outlet to recipient but will typically include a fascine or infiltration well. Roadside rain gardens can be used as chicanes for traffic safety and add green elements to the urban areas.
Permeable surfaces (permeable belægninger)	An example is in the project in Skibhus where the parking spaces along the roads have permeable surfaces that create "green bands" in the area. These will act to collect stormwater and underneath the permeable surfaces there are fascines for storing and percolation.	Using permeable surfaces allows water to seep through or to be stored in a fascine beneath the surface. The central goal of permeable pavements is to control stormwater from cloudbursts, reduce runoff and surface water stagnation and improve water quality in substrate layers via additional filtration. It is suitable for pedestrian and car parks. Permeable surfaces have other benefits like a cooling effect by absorbing water and lowering surface temperatures and permeable surfaces can improve water quality, improvement properties of natural surfaces and vegetation.
Green roofs and walls (grønne tage og facader)	Odense City Center has undergone a historic transformation in recent years. A former 4-lane road has been transformed into a sustainable district with housing, business, cultural institutions and a parking facility with 1000 spaces,	Green roofs are roofs that are planted to form a green surface which soak up some of the rainwater and filter our pollutants. Green roofs can be designed to allow nature and natural inhabitants to colonize on their own. A green roof designed to attract biodiversity

	In this new part we have been using green roofs and walls. An effort that we can see the effect from in the thermal mapping of urban heat. In general OM try to increase the use of green roofs and walls through local planning.	(especially pollinators) as a means to compensate for ecological habitat fragmentation therefore provides opportunities for urban wildlife. Green roofs can reduce the heat island effect. They increase the thermal insulation in the building and therefore reduce the use of energy in heating.
Re-established natural wetlands (Genetablerede naturlige vådområder)	An example is in the rural area of Sanderumgaard where OM established a wetland in 2018. The nearby stream Vejrup Å was re-meandered and water transported to the new wetland area. The wetland prevents about 2,3 tons of nitrogen from reaching Odense Fjord every year.	A re-established or restored wetland is a flooding of an area that historically has been a wetland and has been drained for typically agricultural purposes. Re-establishing wetlands can be used for the purpose of both reducing nutrient loading and/or reducing emission of greenhouse gases.
Constructed wetlands (Konstruerede vådområder)	An example is the Water and the nature project at Everenden. Where a 2.1 km long stream in extremely poor condition is recreated together with a 4-ha wetland.	Constructed wetlands are established with the purpose of introducing and optimizing the self-cleaning processes that are naturally found in wetlands. Constructed wetlands are established directly connected to the drainage system and solely receives drainage water from the drained catchment area. There are two main types of constructed wetlands. The first (A) receives water from a surface flow and the second (B) receives water through a filter basin (subsurface flow) consisting of mineral and/or

		organic material e.g. woodchips and seashells.
Re-meandering streams (Genslyngning af vandløb)	An example is the RECONNECT project in Seden Strandby at the Odense Fjord includes removing low coastal dikes and moving them higher inland and promoting a "self-design" rehabilitating process of establishing coastal meadows. The projects will improve and increase habitats within the Natura 2000 area and improve the protection of populated and agricultural areas from flooding.	Re-meandering stream is the restoration of a canalized watercourse to the natural course and profile before straightening or to a similar natural course. Through re-meandering the stream, the natural morphological processes of the stream will unfold. Another method is to raise the waterbed of the stream to better connect the stream with the surrounding terrain by changing the profile means that the width of the stream and the topography of the bottom are changed to correspond to a more natural state.
Stone reefs	Stone reef established by the Odense Fjord Collaboration in Egensedybet in the northern part of the fjord in December 2024.	The increasing pressure on aquatic ecosystems by eutrophication and climate change require adaptation efforts to restore habitats that are essential to improve ecological conditions and allow the return of biodiversity and ecosystem functions. Stone reefs are important habitats for algae and marine faunal species as they create protection from currents and predators. Stone reefs also create coastal protection by effectively breaking the marine currents and waves, reducing them towards the coastline

Eelgrass	In Bregnør, Odense Fjord the Odense Fjord Collaboration and the innovation company Zostera-Marina plant Eelgrass cuttings. There have also been test-plantings using the manual method at various locations in Odense Fjord to see what stresses the eelgrass. For now, conditions in the fjord are unfortunately still too bad for eelgrass to return to a big scale.	Eelgrass has disappeared from the Danish waters over the last century first due to a wating disease, and later due to the increasing discharge of nutrients (eutrophication), which enhance opportunistic algae and phytoplankton growth. Reestablishment of eelgrass populations by transplanting eelgrass apical shoots, harvested from existing mature beds can be used to assist the natural recolonization
Coastal meadows (re-establishment, landscapped & rewilding) "etablere, konstruere eller genetablere")	The project at Seden Strandby to protect the area from flooding while improving the water quality in Odense Fjord, included re-meandering about 900 m of the streams Seden bæk and Seden Åsum Skelgrøft.	Coastal meadows are developed on grassy salt meadows with species-rich plant communities of salt-tolerant grasses and herbs. Coastal meadows are primarily important for biodiversity and the nature type is habitats for threatened plants, birds and animals. But they are also known to increase sedimentation at the coastline compensating a portion of the average sea level rise. Coastal meadows as a climate adaptation project can be done by re-establishing where there have been coastal meadows previously, by constructing landscaped coastal meadows or by rewilding a nature area to the conditions of coastal meadows.
Re-opening streams (Genåbning af vandløb)	Everenden, Vejrup Å and several other locations.	Re-opening streams is to open streams that are currently closed in pipe systems and re-meandering the stream or raising the water course to

		better connect the stream with the surrounding environment. Piped streams' only function is canalizing water and has no treatment, retention or ecological qualities. By re-opening streams it is possible to restore these functions.
Swales and wadis (Åbne forsyningsrender)	In Bellinge Fælled, OM, in connection with a new city quarter, has sought to create a sustainable zoning, where there is an increased focus on, among other things, the handling of water and the way of life. Among other solutions, swales have been established between houses, which partly function to transport surface water down to the rainwater basins and partly as recreational small paths, where the children can explore in rubber boots.	A swale (or bioswale) is a transportation route for water and is often covered in vegetation. A swale has a wide U shape with slight slopes that, contrary to ditches, are less dangerous and applicable for urban areas next to bike lines or sidewalks. They are often used to drain roads, paths or car parks, where it is convenient to collect runoff, or as a means of conveying runoff on the surface while enhancing access corridors or other open space. A wadi is a kind of swale but includes filter soil for treating and filtering the water peculating through the soil. Runoff from highways includes nutrients, suspended matter and metals like lead, cobber and zinc can be significantly removed by grassed swales and wadis. Therefore, it is also necessary to maintain the wadis for continuous treatment. Where swales are mainly used for water transportation and wadis allows for infiltration and evaporation.

Coastal re-alignment	In 1914 a coastal area project in Gyldensteen Strand on the northern Funen turned what used to be an intensely farmed agricultural area into a coastal lagoon and a fresh water lake.	Coastal re-alignment or managed re-alignment is an engineered and controlled retreat and flooding of areas that were ocean earlier. Managed re-alignment is used as a protection from rising seawaters and storm surges by using the new flooded area as a buffer zone with capacity to retain the water and reduce forces from waves.

Table inventory of a selection of the previously implemented NbS

There has been a wide range of NbS implementations in the Model Region in recent years.

3.4 Local alliances

There are several relevant alliances in the Model Region. The table below lists alliances that have a regional and local geographical scope. Some alliances are spread across Denmark and work to disseminate findings and best practices across the regional divisions like the Climate alliance. Others, like the 6bysamabrejdet discuss issues across the 6 largest cities in Denmark and the Odense Fjord Collaboration work to bring together key stakeholders along the fjord.

Name of the alliance/partnership	**Location**	**Type (formal/ informal)**	**Description and objectives**	**Geographical scope (regional/local)**	**Types of stakeholders involved (e.g., local municipality, farmers association)**
Klimaalliancen (The Climate Alliance)		Formal	Supporting implementation of municipal CCA plans and fostering intermunicipal/ regional collaboration and	The alliance is divided into regional groups. Funen is part of the region in southern	All (98) municipalities, KL, all (5) Danish regions, CONCITO, C40 Cities

			knowledge exchange	Denmark which consists of Funen and the southern Jutland area.	
Naturpark Lillebælt	The Lillebælt area on the western Funen and Jutland	Formal	Increasing biodiversity in Lillebælt	Regional	Fredericia, Kolding and Middelfart municipalities
3vand		Formal	Strategic partnership across the water utilities from three largest cities in DK	Regional	The water utility companies: Aarhus Vand, VCS, HOFOR, BIOFOS
6by collaboration (6-by samarbejdet)		Formal	Collaboration between the six largest municipalities in DK. Knowledge-exchange on budgets and service levels.	Regional	Cities of Copenhagen, Aarhus, Odense, Aalborg, Esbjerg, Randers
DNNK - National Network for Climate Adaptation		Formal	Paying members incl. regions, municipalities, businesses, utilities, knowledge institutions and interest organizations	Regional	Network and knowledge sharing platform on CCA, incl. webinars and events

Vidå-samarbejdet		Formal	CCA initiatives in the Vidå catchment	Regional	Tønder and Aabenraa Municipality, knowledge institutions and interest organizations, Region Syddanmark
The Odense Fjord Collaboration	The Odense fjord catchment area	Formal	Actors (private, public) along Odense Fjord focused on improving the status of the fjord (water management, aquatic environment etc.)	Regional	Four municipalities on Funen, incl. Odense, Danish Society for Nature Conservation, SDU, VCS and other utilities, Danish Horticulture, SEGES Innovation, Odense Port and other businesses
GeoFyn	Funen		Geodata collaboration across Funen	Regional	Owned by municipalities on Funen: Middelfart, Nordfyns, Odense, Kerteminde, Assens, Faaborg-Midtfyn, Nyborg, Svendborg, Ærø, Langeland

Kystvandsrådet in Odense fjord	The Odense fjord catchment area		Council established to recommend local approach to reach climate goals	Regional	OFC, SDU, VCS.
Odense Klimapartnerskab (Odense Climate Partnership)	OM		Collaboration across actors in Odense (private, public) to foster cooperation to find solutions to challenges of climate change	Local	3C Groups, Universal Robots, Energi Fyn, H.J. Hansen Koncernen, SDU, Jysk Fynske Media, Fjernvarme Fyn, VCS, Odense Renovation, Odense Harbour, OM, TASFO and currently expanding its partners.

Table local alliances in Model Region Funen

All partners of Model Region Funen hold previous experiences and tools that are relevant to integrate or develop further as part of the ARCADIA project.

Data and tools

Data and reports produced in the EU funded project, OdenseModellen, will be part of the knowledge base of the ARCADIA project. The OdenseModellen project was a collaboration between OM and the utility company, VCS, funded by the EU Regional Fond. In the project, OdenseModellen, a Life Cycle Assessment (LCA) tool was developed to evaluate the difference in resource usage and CO_2 emissions in water management measures on the terrain and below the surface. The material produced in the project includes masterplans for all water catchments of OM and catalogues of measures for water management on terrain that will feed into and support the Co-Innovation Labs in Model Region Funen when relevant.

Two relevant tools in relation to socio-economic assessment of climate adaptation are also expected to be used throughout the ARCADIA project.

Partly the tool BEST, which was developed by the consulting company NIRAS and which follows the Danish legislative model for assessing the societal appropriateness of climate adaptation projects - including the socio-economic assessment.
Partly the Damage Economic tool (SkadesØkonomi), which the ten Funen municipalities under GeoFyn have collaborated with the Technical University of Denmark (DTU) to develop based on a model from DTU. This model includes a far greater range of benefits from climate adaptation and thereby gives nature-based solutions more value than a more technical solution, as the nature-based solution will, in addition to handling water, also have a positive effect on biodiversity, health, house prices, etc.

The Danish legislation only gives the opportunity to assess water management, as the intention of the law is to ensure that VCS will not pay for anything other than just water management.

The combination of the two tools for assessing nature-based solutions is therefore extremely important, as SkadesØkonomi can make the benefits in addition to water management visible. Benefits that private investors or OM must finance in order for the project to be implemented.

The legislation has been much maligned, as it can prevent the utility from choosing the cheapest solution, simply because cross-cutting financing has not been in place at the same time and otherwise complicates ownership and future operations unnecessarily.
More on this under 3.7 Challenges and opportunities.

Projects and networks
The Elite Centre of Aquatic Nature-based Solutions for Climate Change Adaptation and Mitigation is part of the University of Southern Denmark where the innovative Climate Cluster under prof. Sebastian Mernild is leading research activities in the region. This centre holds expert knowledge on nature-based solutions, ecosystem services, coastal nature and freshwater systems that will feed into the project, both as part of Model Region Funen (WP5) as well as Design and Performance of Nature-based Solutions (WP8).

VCS, the utility company, is part of multiple water management projects and is a leading stakeholder on implementation of SUDS to manage stormwater on the terrain. Odense City has many good examples of SUDS projects supporting biodiversity and water quality which VCS has led together with local citizens and OM.
The key alliances for Model Region Funen are sketched out below and divided between national, regional and local alliances:

A central regional alliance for the dialogue and dissemination of NbS in Model Region Funen is the Climate Alliance. Model Region Funen and the Climate Alliance have formally agreed on the continued transversal exchange of knowledge and results between the parties. The Climate Alliance is a continuation of the national DK2020 project where the five Danish

regions and KL (Danish Local Government) have supported all 98 municipalities in Denmark in the formulation of climate action plans in accordance with C40's international standards. The Climate Alliance consists of both regional and national structural organisations broadening the reach and scope of the alliance. Within the geographical region of Southern Denmark, a peer-group of municipalities is organised around exchanges on climate adaptation where Model Region Funen will share results and gain inputs and feedback for further development. On the national level in the Climate Alliance, Model Region Funen will participate in events and conferences to present findings and results to expand the reach of the results. The Climate Alliance is a key stakeholder in the implementation of Labs 2 and 3 where a catchment-based and regional approach will be essential to involve the relevant stakeholders.

3.5 Co-Innovation Laboratories

The following describe the three co-innovation laboratories and their focus.

3.5.1 Location, Duration and Objectives

Co-innovation Lab	Location	Duration	Objectives
Lab 1	The urban area of Vollsmose in OM	October 2024 – June 2025	focus on measures to support sustainable urban drainage on a local scale. The goal of the lab is to bring the relevant stakeholders together and produce recommendations for how to use nature-based solutions to manage the discharge and reduce the potential negative consequences on the water quality in the system.
Lab 2	The Odense Fjord catchment	May 2025 – March 2026	will have a catchment-based approach focused on improved water quality in Odense Fjord. The goal of the lab will be to highlight the connection between activities upstream in the catchment area and the impact lower in the system and the fjord that is needed to promote a more systemic approach to water management.
Lab 3	Odense Fjord and River upland	March 2026 –	regional blue-green infrastructure and the connection between natural, semi-natural

		November 2026	and man-made (recreational) blue and green areas.

Table Co-innovation labs in Model Region Funen

The three Co-innovation labs run according to the above schedule. Before the official start of the lab (dates listed above), there is a preparation over a few months that overlaps with the ongoing lab.
Regarding Lab 2, the selection process of identifying a river of interest for all leading partners in the lab started in November 2024. The following month the tasks of the lab will be identified, and the analysis/data collection will take place from May 2025 for the sake of collecting data when there are favorable weather conditions for this. Similarly, the preparation of lab 3 will begin a couple of months before March 2026.

The partner organizations in Model Region Funen partake in various engagements in the different Co-innovation labs.

	Model Region Funen partners who will lead the work
Lab 1	OM, SDU, VCS
Lab 2	OM, SDU, OFS
Lab 3	OM, RSD, VCS

Table lead partners in the co-innovation labs

The partners who are involved in the labs are responsible for dividing the responsibility for coordination and securing progress of the agreed activities, analyses and to continuously collect insights for the deliverables that report on the labs. The project group representatives in the Model Region Funen are responsible for quality assurance. The collaboration works to ensure that the partners who are not directly involved in the lab also partake in securing the connection between the labs and the motion towards upscaling. This is ensured by inviting all partners to participate in selecting the sites for the labs to promote a holistic view on the work and contribute to the revision of the deliverables about securing connection between the labs.

3.5.2 Expected Outcomes

The activities in Model Region Funen are expected to result in the following outcomes:

1. Data and a stronger knowledge foundation on NbS to support solutions across the water system including water quality, biology and social drivers for action.
2. Enhanced political awareness on the multifunctionality of NbS with the aim of influencing higher levels of governance to facilitate policy tools for the implementation of NbS.
3. Increased regional and international collaboration through shared activities and improved understanding of approaches and interests of each of the partners.

4. Masterplans for water management developed to promote holistic planning and NbS as key approaches for climate adaptation in municipal planning.
5. Example of finance strategy on NbS to highlight potentials in mixed finance schemes combining public and private investments.

Model Region Funen has set ambitious goals for the completion of Co-Innovation Laboratories (labs) that focus on bringing research and urban planning closer together. In Model Region Funen, three Co-Innovation Labs will be designed with the aim to facilitate dialogue between stakeholders and take a multifunctional and -disciplinary approach to water management and nature-based solutions. The Co-Innovation Labs have been selected to activate the local Climate and Environment Committee in OM to facilitate a political dialogue on water management, climate adaptation and nature-based solutions for the future development of OM. With the Co-Innovation Labs, the goals are to:

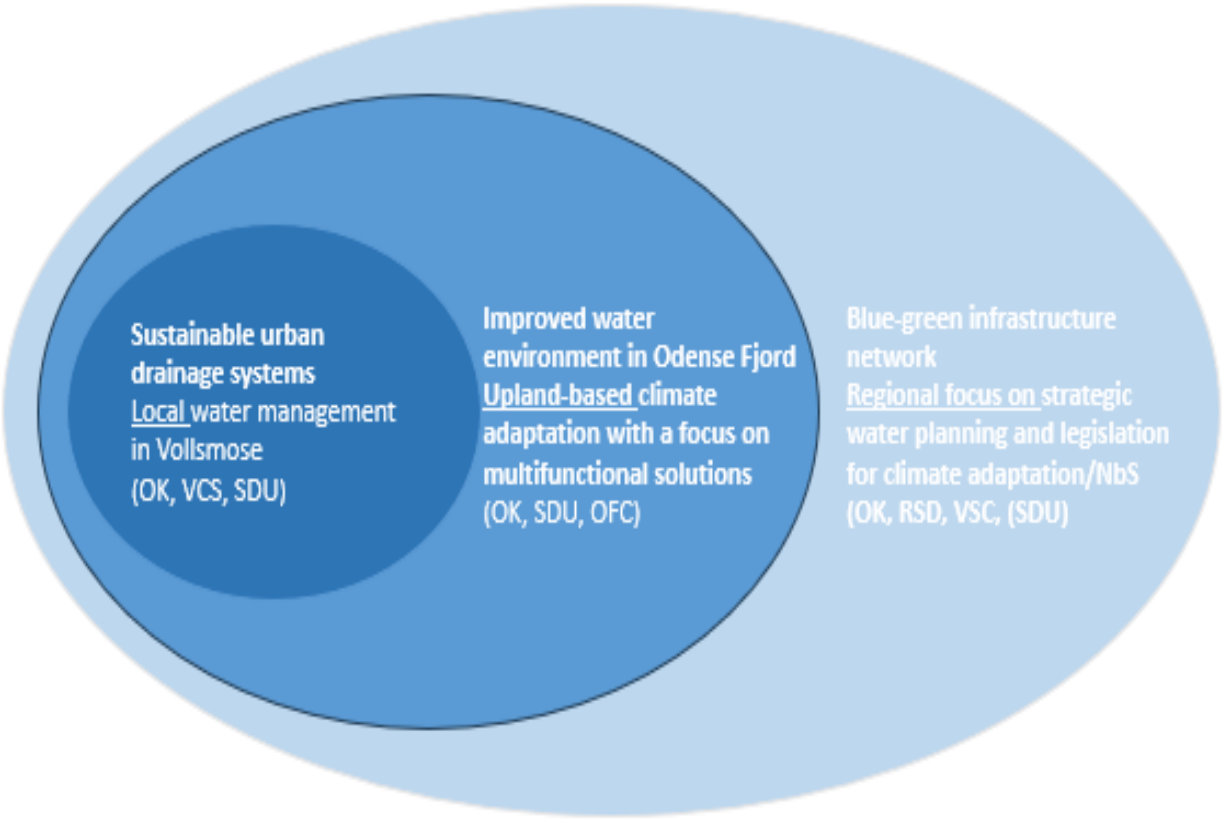

Figure 9 focus of the three co-innovation labs in Model Region Funen

Co-Innovation Lab 1 will focus on measures to support sustainable urban drainage on a local scale. The goal of the lab is to bring the relevant stakeholders together and produce recommendations for how to use nature-based solutions to manage the discharge and reduce the potential negative consequences on the water quality in the system. These recommendations can feed into a process of identifying the best

solutions to be integrated into a financing model for the implementation of the project in the future. The financing model will focus on integrating water management, biodiversity, and urban green spaces with a view to increasing people's quality of life and to create added value in the area.
The lab will take place in a selected case area which faces challenges with rising shallow groundwater and stormwater management in old pipes. The area is called Vollsmose and lies centrally in OM connected to the Odense Fjord and river. Vollsmose is Denmark's largest socially vulnerable residential area where around 90 different nationalities are represented.
The population of the area is diverse and with the planned transformation of the area including demolition of housing blocks, construction of new housing, infrastructure, water management; leisure, green and recreational spaces and a new light rail.
The area faces comprehensive changes. A water management plan for the area is underway (expected in January 2025) and will be the basis for the work carried out by the water utility company, VCS. As part of Lab 1, SDU will support this task through data collection and examinations of the quality of the area's lakes and streams, biology, and water discharge.

Co-Innovation Lab 2 will have a catchment-based approach focused on improved water quality in Odense Fjord. The goal of the lab will be to highlight the connection between activities upstream in the catchment area and the impact lower in the system and the fjord that is needed to promote a more systemic approach to water management. The lab will include research activities focused on the aquatic environment in the fjord, to be carried out by SDU. Recommendations for solutions with a positive impact on the aquatic environment and recreational elements along the fjord will be developed with the involvement of relevant partners, especially the Odense Fjord Collaboration – a private-public collaboration between stakeholders along the fjord.

Model Region Funen will define more specific goals and site/case selection of lab 2 during an iterative process starting in November 2024 to secure the optimal connection to ongoing activities in the partner organisations. Links to other projects will be sought to be integrated in a way in which the research and development activities in Model Region Funen can result in added value and foster more value in ongoing or planned activities. With a catchment approach, Lab 2 will investigate the potential connection between activities in projects such as LIFE Ring and the planned formulation of a land procurement plan (kommunale omlægningsplaner, Den Grønne Trepart)[25] for the Odense River. The land procurement plan will be formulated during 2025. Research and data from Model Region Funen will feed into and benefit from this work.

[25] Kommunale omlægningsplaner som del af den Grønne Trepart

Model Region Funen will facilitate dialogue between the neighbouring municipalities sharing catchment to the fjord to promote holistic approaches and collaboration on measures to improve conditions in the fjord. Through the regional networks in the Climate Alliance and Odense Fjord Collaboration, Model Region Funen will organize a workshop on common challenges and potentials for implementing nature-based solutions focused on the fjord. This work will also develop a collaboration model between the relevant stakeholders.

Co-Innovation Lab 3 will focus on a regional blue-green infrastructure and the connection between natural, semi-natural and man-made (recreational) blue and green areas. The Co-innovation laboratory will have a regional approach focused on strategic water management and policy integration of nature-based solutions. Model Region Funen will define project goals and site/case selection of lab 3 during an iterative process starting in fall 2025 to secure the optimal connection to ongoing activities in the partner organisations.
OM will, along with relevant stakeholders, organise a process on spatial planning and water management in municipal strategic developments. OM is characterised by a high spatial occupancy rate and there is limited space for the multiple initiatives on water management infrastructure, nature, biodiversity, sustainable energy, new development etc. To promote a multifunctional use of space, the partners will work on identifying a case to promote strategic water management planning together with VSC and one or several municipalities connected to Odense Fjord and the river upland.

A goal of lab 3 will be to influence current legislation on water management based on the knowledge and experiences produced in Model Region Funen. Through meeting activity and events, the partners will promote holistic water management and nature-based solutions as a driver for change.

To ensure broad dissemination of the results of the three labs in Model Region Funen, the partner Region of Southern Denmark or an organization with the same engagement in projects and networks will work to leverage and engage relevant stakeholders in dialogue on climate adaptation and nature-based solutions.

3.5.3 Stakeholder Engagement

Stakeholder Mapping

The Stakeholder mapping reflects the narrow towards a broader perspective and in this case refers to groups or organizations outside The Model Region Funen consortium. The Stakeholders in relation to Co-innovation lab 1 are primarily organisations centred around the area of Vollsmose, that the scope of the Lab focuses on. Due to the vast plans for transformation in the area especially the development company Fremtidens Vollsmose (Future Vollsmose) and the potential contractors that are going to work in the area are identified as the initial stakeholders.

Co-innovation Lab	Location	External stakeholders
Lab 1	The urban area of Vollsmose in OM	SDU Motivation Science Department, Fremtidens Vollsmose, potential contractors, Vollsmose Public Library, other local stakeholders include the social housing organisations, the nursing home, the church, a public school and gymnasium.
Lab 2	The Odense Fjord catchment	The Climate Alliance, neighbouring municipalities: Kerteminde and Nordfyn, landowners
Lab 3	Odense Fjord and River upland	The Climate Alliance, Agenda Earth project, neighbouring municipalities in the Funen region, relevant ministries/agencies and landowners/development companies.

Table external stakeholders

The Second co-innovation Lab's focus is on the catchment of the fjord. Therefore, the key stakeholders of this lab are identified as the landowners in the catchment areas and the neighbouring municipalities OM, Kerteminde and Nordfyn are key stakeholders. The main stakeholders are organized in the OFC who is a partner in the Model Region Funen and a part of the work group of the second lab. Therefore, it is natural that the stakeholder dialogue builds upon the existing knowledge, shared vision and network.

The third co-innovation lab zooms further out and focusses on the regional blue-green infrastructure and the connection between natural, semi-natural and man-made (recreational) blue and green areas. Therefore, the stakeholders consist of regional initiatives like for example the Climate Alliance which is a partnership organised between the local government Denmark (KL) and the five Danish Regions[26]. The municipalities in the broader upland to the Fjord are also stakeholders in relation to co-innovation lab 3 and they also partake in the OFC. The relevant ministries and agencies are naturally important stakeholders too. Lastly, the interdisciplinary participants of the Agenda Earth project[27] are possible stakeholders in relation to work with recommendations for policy to simplify the management of water in Denmark.

[26] The political landscape is changing as this report is being finished. The project will assess the situation and select the most relevant stakeholders to target in supporting the upscale.
[27] Agenda Earth project

Key projects for knowledge exchange and collaboration:

D4RUNOFF
D4RUNOFF will create a novel framework for preventing and managing the pollution from stormwater that is leading to overworked and inefficient wastewater systems, allowing potential harmful pollutants and contaminants to infiltrate the surrounding environment[28]. Horizon project.
DK-partners: VSC utility company, OM, GEUS, University of Copenhagen

LIFE Ring
Nature restoration project funded by EU's Nature and Biodiversity pool. Ten municipalities in the Funen region, including OM, the Nature Agency Funen, the Danish Environmental Protection Agency, Amphi Consult, Skovskolen, FGU FYN and Naturama are behind the LIFE Ring biodiversity project, which has a budget of DKK 119 million [29]and will run over the next eight years. The project aims to create good, varied and robust habitats for characteristic and rare animals and plants through new and improved nature areas.

Blåt Danmarkskort (Agenda Earth)
The project combines the professional skills of architects and lawyers in a joint effort to link the development of our physical environment with the legal framework and thus ensure a new balance between our cities, landscapes and nature[30].
Supported by the Dreyer Foundation and operated in collaboration with the Danish Architects Association and the Danish Bar and Law Society (Advokatsamfundet).

NBRACER
NBRACER works with Demonstrating and Replicating regions in the European Atlantic biogeographical area to envision and co-design place-based sustainable NbS that are at one with the regional landscape[31]. Horizon project.
DK-partners: Aalborg University, Klimatorium (Lemvig Vand)

Engagement Approaches

Dialogue between Model Region Funen and ARCADIA partners
Through the labs organised in WP5, Model Region Funen partners will engage in crosscutting dialogue to promote collaboration and common understanding of NbS. This dialogue is aimed at facilitating a strong partnership both within and beyond the ARCADIA project. The international network of partners in ARCADIA can generate practices of collaboration with strong results from multiple technical fields and

[28] D4RUNOFF - Preventing and managing pollution from urban water runoff
[29] Approximately 15.956.888,50 EUR (converted 20241211).
[30] Hvem ejer vandet?
[31] NBRACER - Nature based solutions for Atlantic Regional Climate Resilience

organisations. It is the hope that the annual General Assembly and Festival will contribute to dialogue between the partner organizations across. It is furthermore the ambition to arrange an exchange visit to the Model Region Skåne in 2025 to network and exchange knowledge between project partners working with similar challenges in a model region close to Funen.

Engagement of civil society groups
Partners of Model Region Funen will engage and involve various stakeholders in the civil society as part of the Co-Innovation Labs. The stakeholders will be selected in relation to the Lab objective.
In Lab 1, workshops will focus on the local project area and involve stakeholders, including civil society groups, to take part in dialogue on the transformation of the area and recommendations for future nature-based solutions.
Lab 2 will organise dialogue with stakeholders from neighbouring municipalities sharing the catchment to the fjord. The dialogue will focus on common challenges and NbS/BGI solutions benefiting the fjord from a catchment-based perspective.
Lab 3 will organise dialogue between stakeholders in the Odense Fjord and river upland with the aim to promote strategic water management planning.
The dialogues can be organized in various ways fx. meetings, presentation of findings from co-innovation labs, workshops and the like and will be determined in the iterative planning of the co-innovation labs. The specific planning of the co-innovation labs two and three will take place concurrently with the execution of the previous lab.

3.6 Upscaling resilient transformative change

In October 2024 the Model Region Funen hosted a workshop to test the self-assessment scorecard that is under development in the ARCADIA work package no. 7. The overall purpose of the workshop was to test the scorecard itself but during the scoring of the different steps of the test the participants engaged in reflections and perspectives on the status of the Model Region.
During the test of the score card the project group discussed the Model Region Funen. The political and legislative reality in which we operate has been in the process of preparing the grounds and building a shared vision for some time. There have been initiatives taken from the municipalities in adopting certified climate adaptation plans and building a shared vision and common understanding of the desired state they are aiming for. Therefore, the vision and political commitment towards upscaling are present.

The reflections on the upscaling potential of the work in Model Region Funen is based on the reality that the overall political focus is on close competition to other political agendas and the distribution of funding is characterized by prioritizing limited budgets. The actions that define the pathways and concretize projects and initiatives that constitute the next step towards upscaling in the resilience journey is characterized by an overall focus on

adaptation in relation to certain areas that receive political attention and get prioritized and those in relation to resilience, who awaits funding for example draught and urban heat initiatives. The municipal certified adaptation framework (C40) secures the broader focus on resilience and the revision cycle of the initiatives secures the translation of the visions into actionable steps and provide the municipal decision makers with an ongoing progress status on the selected topics in the framework and direct, adapt or adjust accordingly.

Model Region Funen aim to leverage multiple opportunities to upscale the activities to impact a broader and lasting change:

1. Through the local and regional alliances, especially the Odense Fjord Collaboration and networks such as the Climate Alliance, Model Region Funen will share and upscale activities with relevant external stakeholders through meetings and joint events.

2. Results of Model Region Funen will be sought integrated into municipal planning documents and workflows. Facilitating a cross-cutting collaboration between technical fields and organisations will create stronger ownership of the elements included in the revisions of municipal, risk and climate adaptation planning. As part of ARCADIA, Model Region Funen aims to formulate strategic water management plans with the purpose of planning water management to counteract the consequences of climate change by mapping the risks and proposing recommended actions. One example is the development of the action plan for water management. As a political tool, the aim of the action plan is to promote initiatives targeted at multifunctional purposes and consider blue-green infrastructure before urban development and construction as a strategic principle.

3. The Co-Innovation Labs will result in recommendations for NbS to be part of future plans for urban drainage and the broader management of water quality and quantity in the Odense Fjord as well as develop a collaboration model between key regional stakeholders. These activities will continue following the project.

4. The Model Region Funen partners will seek to influence revisions of existing and coming policy at national level through meeting activities, policy briefs, presentations and the like. Through the preparation of policy briefs, there is great potential in organising these efforts between multiple stakeholders both within and outside the ARCADIA partnership (see *Key projects for knowledge exchange and collaboration*).

3.7 Challenges and opportunities

The Danish political landscape is changing now and that proposes both challenges and opportunities. A green agreement - Den Grønne trepart - and a new ministry of the green agreement have been established in November 2024[32].

[32] Aftale om et Grønt Danmark

The new ministry promotes a green area fund to allocate funds to projects acquisition of farmland which will provide more space for nature and better conditions for biodiversity and drinking water protection. The fund can provide funding for projects that can benefit the fjord. The situation possesses an opportunity to impact co-innovation laboratory 2. The areal fund proposes opportunities in the Odense Fjord catchment area that can benefit the aquatic environment. But the situation can also be a challenge as hesitancy and uncertainty can affect the dialogue with landowners, as they might be prone to speculate to a greater extent in the value of their land. The partners will assess the situation continuously.
A Reform of the regional authority levels have been announced and are at the time of writing being assessed. The regional level historically worked within the resort area of both health and climate- and environmental issues. The future of the regional role will only be about health and environmental issues, the climate issues are deprived from the resort area. The timeframe of these changes and uncertainty about the regional role in the climate alliance networks continuation and in which constellation remain to be clarified in the following months[33]. The partners in the Model Region will ensure that the assigned tasks of lab 3 and the upscaling regarding the dissemination of knowledge and levers of impact on policy and legislation will be secured.

The partners of Model Region Funen will be vigilant to seek out opportunities for further integration of complementary projects or funding to support the overall ambitions of the region. This includes, but is not limited to, cascading funds for complementary activities, political goals and opportunities to support promoting areas in climate change adaptation that could benefit from additional funding.
The partners will furthermore be monitoring of relevant events for dissemination of results, including Klimafolkemødet[34] (People's Climate Conference), Det Nationale Klimatopmøde[35] (the National Climate Summit), REBOOT[36], EU Missions Forums and others to support knowledge transfer and promote research on Nbs/GBI.

4. CONCLUSIONS

The Model Region Funen is working towards bringing NbS further in terms of a solid research and data foundation in combination with promoting solutions in political decision-making processes. The aim is to build knowledge and planning material that brings NbS closer to implementation to support the region in becoming climate resilient. With NbS, the partners seek to show how multiple challenges can be met by holistic and

33 regioner.dk/services/nyheder/2024/november/sundhedsreform-rammerne-er-paa-plads-nu-skal-vi-samarbejde/
34 Klimafolkemoedet.dk
35 Det Nationale Klimatopmøde
36 REBOOT

multifunctional solutions inspired by nature and natural processes. This will be organised through stakeholder workshops, citizens science and dialogue. The results and experiences will be implemented in policy and plans as well as finance strategies.

ANNEX Overview

- Annex 1 Executive summary action plan for water management – OM December 2024.
- Annex 2 Vision of the Odense Fjord Collaboration. December 2024.

Co-funded by the European Union

Annex 1 - Executive summary of Action Plan for water management

The Action Plan for water management builds on the Climate and Environmental Administration in Odense Municipality's work to improve water quality. It has been developed in conjunction with the Climate and Environmental Administration's participation in an EU Horizon-funded research and innovation project, ARCADIA, which, among other things, will develop proposals for comprehensive water management plans in the form of nature-based solutions and blue-green initiatives based on a holistic approach. The comprehensive plans will include calculations and proposals for water management solutions in three innovation laboratories, first focusing on urban drainage in Vollsmose, then on improved water environment in Odense Fjord and its catchment area, and finally on strategic water planning in a blue-green infrastructure network.

A holistic approach to planning and projects
The action plan for water management focuses on a range of initiatives under four main areas:

- Synergy and cooperation
- Cleaner groundwater
- Living streams
- A vibrant fjord

By focusing on the synergies that can be achieved with a holistic approach to planning and projects that impact the water cycle, the action plan's efforts can contribute to creating an attractive city with urban nature, biodiversity, and well-being for the city's residents. This supports Odense's City Strategy ambition to think green and blue before we talk about construction, with the goal of becoming a climate-neutral, healthy, and livable city by 2035. Odense Municipality's vision of creating balance in urban development is tied to a shared responsibility for the 9 planetary boundaries, which globally have been exceeded for biodiversity, pollution with environmental contaminants, greenhouse gas emissions, nitrogen and phosphorus emissions, land use, and our consumption of freshwater. All these parameters have, to a greater or lesser extent, significance for or are affected by the state of the water.
By taking the water cycle as a starting point, thinking in terms of multifunctionality, and engaging stakeholders, the action plan's efforts highlight and accelerate initiatives that cut across and simultaneously draw attention to areas and contexts currently perceived as secondary, both in terms of content and funding models.
The plan focuses on the extent to which the highlighted efforts have the potential for synergy by indicating the effects across:

- Wet nature
- Fjord

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- Groundwater
- Streams
- Climate adaptation

Multifunctional Land Use Creates More Space
The biggest challenge in improving water quality in Odense Municipality is that the best solutions require space – something Odense, as an urban municipality, is challenged by. Therefore, new solutions must be considered that contribute to multiple bottom lines, such as purchasing agricultural land to relieve nutrient input to the fjord, giving water and nature space, and contributing recreational qualities. The Climate and Environmental Administration therefore proposes establishing a local fund for "Blue-Green land acquisition". The idea is that the fund aims to purchase properties and areas to realize projects that promote selected efforts for nature, water management, and the overall water cycle. With a cross-sectoral and interdisciplinary approach, the funds for Blue-Green land acquisition can benefit multiple agendas and link solutions based on the local context. By thinking across sectors, it is expected to become even more realistic to gain a share in the newly established Denmark's Green Area Fund, which was established with the broad sectoral agreement on the Green Tripart.
An effort in the plan that also supports multifunctional land use is the establishment of partnerships. In this context, the ambition is to encourage holistic thinking where possible in close cooperation with stakeholders along the water cycle.

Comprehensive Plans for Water Management
In larger urban development and urban transformation projects, Odense Municipality wants to see the areas in question by developing water management plans for entire areas. This will create opportunities for solutions across planning boundaries, as well as create space for coherent and more holistic solutions. This is to ensure, as far as possible, a healthy balance between urban development in a situation where space is limited and at the same time promote nature, the water environment, and Odense Fjord.
Throughout the action plan's development, emphasis has been placed on involving key stakeholders: various departments across Odense Municipality, Vandcenter Syd (the local water utility company), Odense Fjord Collaboration, the Green Council (local nature and environmental NGOs), University of Southern Denmark and the Region of Southern Denmark.

Read more about the initiatives in the Action Plan for water management on Odense Municipality's site.

Annex 2 - Vision of the Odense Fjord Collaboration. December 2024.

Description of the process towards the new strategy for Odense Fjord Collaboration

As part of the deliverable 5.1 of the ARCADIA-project, this is a description of how the updated strategy of the Odense Fjord Collaboration (from now on OFC), one of the local partners of the ARCADIA project in Model Region Funen, came into place.

Background

As most Danish coastal waters and fjords, Odense Fjord is under pressure. High levels of nutrients lead to a massive algae growth in the warmer months, causing essential species such as eelgrass to disappear and food chains to collapse. Improving the quality of an ecosystem - in this case in the water - is never an easy task, as many parameters are involved. To help restore balance, a holistic outset is necessary to identify and implement the right measures. Accordingly, a wide range of stakeholders need to coordinate and interact to create change. Considerations like these, combined with a strong, local bond to the fjord, made relevant partners meet up and initiate Odense Fjord Collaboration in 2021.

Odense Fjord Collaboration is a local network of 17 partners - ranging from businesses, local authorities, an agricultural organisation, the university and an NGO.

The original strategy

Together, the partners set the goal of improving the ecological condition of Odense Fjord by 2027, following the EU water framework directive. Together, all partners agreed on four simple, yet effective, principles for a constructive work environment. Those include an evidence-based approach, making knowledge the foundation for all activities. Furthermore, the partnership relies on respect for each other's diverse interests and competences, and seeks to find compromise through dialogue. The main focus is, however, on taking responsibility and action together in order to help the fjord regenerate.

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The process towards the new strategy

In late spring of 2024, the board of OFC decided to launch the development of a new strategy for the OFC, as they wanted to revitalise the organisation and change the focus towards a more action-oriented approach.

The secretariat's work on the topic started in the summer of 2024, when interviews were conducted with 13 partners of the OFC. The remaining four organisations are represented in the board and gave their input through this channel. The interviews were semi-structured and typically with the heads of the respective partner organisation, or the main contact person. The interview guide focused both on the status quo – how the partners perceive OFC in general, its strengths and weaknesses up until the point of the interview and later shifted perspective into the future, with questions such as "Which focus areas are most important for OFC in short and long-term, seen from your perspective?".

Due to the semi-structured method of the interviews, the partners were able to elaborate on certain topics or to bring up other issues. There was also space to discuss concrete project ideas or the overall communication of OFC – all input was welcome.

When all interviews were conducted, we marked the most important points from each interview transcript and started gathering those in order to see the bigger picture in the replies.

Outcomes

To mention a few, the most positive aspects of OFC, according to the partners, were the strong purpose, partnership and focus on local, evidence-based solutions. On the more challenging side, many interviewees criticized the lack of real action in order to improve the fjords' status. Several also challenged the 2027-goal, deeming it unrealistic to achieve within the timeframe.

These were just a few of the many points from the interviews that we presented at a workshop with our board in September. They also had the chance to come with input from their own organisations at that occasion. We also discussed the overall headlines the partners' inputs left us with, in order to work out the first draft of the new strategy.

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The first draft (around 80% ready) was then presented to the board at a meeting in November. They only had a few remarks, which were incorporated.

Validation

The secretariat of OFC then brought this new strategy along to visits with all our partners to present the outcome and gather feedback. All partners were pleased with the result and could see that their inputs had influenced the work. There were a few wishes for new or different wording, which were incorporated. The board is going to approve the final version of the new strategy at their meeting on December 19th, 2024. The new version is translated to English below (slide 4).

The new strategy is primarily for internal use within OFC, that it why we use formulations such as "the four basic principles", which reach back to the original foundation of the OFC that many partners referred to in the interviews and which we therefore mention explicitly in the new strategy, as they are still very much valid and important to the partnership. The strategy is going to be complemented by a more concrete "project plan" in the spring/summer of 2025.

Regarding ARCADIA

The whole process also was a part of this ARCADIA-delivery. That is why we in the interviews were extra curious, when partners brought up issues related to climate adaptation or nature-bases solutions. We also explicitly asked about it, if they didn't bring it up by themselves. Most partners were content with keeping the OFC's primary focus on reaching good ecological condition, which it has been from the start, in order not to scatter our focus too much. However, the majority agreed that whenever possible, multifunctionality and nature-based solutions must be a part of the projects, the OFC engages in. That is why the formulation "We will initiate and facilitate more projects with a *focus on nature-based solutions*, as well as nature restoration efforts both in the fjord and on land." was added. In general, the "action" – theme is the most important one of the new strategy. The board wants the secretariat to focus around 60-70% of its time on this theme, which going to be more visible in the upcoming action plan.

Moreover, partners are informed about and involved in the ARCADIA-project at every relevant occasion to make sure they also bring these insights to their work.

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Odense Fjord Collaboration Strategy from 2025

Description of purpose

Odense Fjord must have the prerequisites in place in order to reach good ecological status in 2027, based on the four basic principles. Therefore, we collaborate and combine our knowledge, resources and competences.

Themes

KNOWLEDGE

- Knowledge is the foundation for everything we do.
- We will continue to work to ensure that our actions and efforts take place on an informed basis.

ACTION

- We will initiate and facilitate more projects with a focus on nature-based solutions, as well as nature restoration efforts both in the fjord and on land.
- We will work to become better at activating each other, involving each other and strengthening our common professionalism and competences.

INSPIRATION

- We want to mark ourselves (inter)nationally by seeking political understanding and influence as well as forums and opportunities to share our experiences, so that the outside world can learn from our work.
- We will attract investments by being thought leaders in the area of nature restoration.

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