RESIST

Reporting on climate adaptation projects in the Central Denmark Region

26th June 2025

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

More information at resist-project.eu

Twitter: @RESISTProject

LinkedIn resist-project

Deliverable Name	Reporting on climate adaptation projects in the Central Denmark Region
Related Work Package	WP3
Deliverable lead	Central Denmark Region
Author(s)	Sørensen, Danielle Veje Højholt (VIA UC (formerly Central Denmark Region))
Contact	das@via.dk
Reviewer	ERRIN, INOVA+, SINTEF, Adelphi
Project Full Name	Regions for climate change resilience through Innovation, Science and Technology
Project Acronym	RESIST
Grant Agreement Number	101093968
Instrument	Innovation Action
Start date	01/01/2023
Duration	60 months
Type of Delivery (R, DEM, DEC, Other)[1]	R
Dissemination Level (PU, CO, CI)[2]	PU
Date last update	26/06/2025
Website	resist-project.eu

Revision nº X	Date	Description	Author(s)
0.1	31/01/2025	First draft	Sørensen, Danielle Veje Højholt (Central Denmark Region)
0.2	29/03/2025	First internal review	Erbacher, Anna (Adelphi)
0.3	10/04/2025	Second internal review	Moualil, Ines (Errin)
0.4	10/04/2025	Coordinator review	Balionyte-Merle, Vilija (SINTEF)
0.5	05/06/2025	Final draft	Sørensen, Danielle Veje Højholt (VIA UC)

Please cite this deliverable as:
Reporting on climate adaptation projects in the Central Denmark Region of the RESIST project funded under the EU Horizon Europe programme

[1] **R**=Document, report; **DEM**=Demonstrator, pilot, prototype; **DEC**=website, patent fillings, videos, etc.; **OTHER**=other
[2] **PU**=Public, **CO**=Confidential, only for members of the consortium (including the Commission Services), **CI**=Classified

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

1 Introduction

This report presents an evaluation and summary of three multifunctional climate adaptation and infrastructure projects in the Central Denmark Region: 1) the Narrowing of Thyborøn Channel, 2) the Climate Ribbon in Randers, and 3) a dike and embankment project in Horsens which is currently on hold. The primary purpose of the report is to examine and assess the status, progress, and implementation plans of these projects. The aim is to highlight results and lessons learned that can contribute to the planning and execution of future climate adaptation initiatives.

Notice, the three projects are still ongoing. As such, some sensitive details cannot be disclosed or elaborated upon at this stage. This is due to political, economic, and environmental aspects are still under discussion. Consequently, the scope and depth of this report are limited by these circumstances.

It is important to note that the projects were developed and initiated by the respective municipalities of Lemvig[3] (on behalf of the seven municipalities of the Western Limfjord), Randers, and Horsens. The project ideas originated from the EU project Coast to Coast Climate Challenge (C2C CC), which served as a platform for knowledge-sharing and inspiration. Since their inception in C2C CC, the three projects have been further developed and adapted by the respective municipalities. In this process, the Central Denmark Region has contributed through sparring and guidance but has not played a direct implementing role.

This report consolidates the experiences from the three projects to identify valuable insights and challenges that can inform future climate adaptation strategies across the region and municipalities. Central themes and issues have been continuously identified, ensuring the report focuses on the key aspects of the projects' implementation and lessons learned.

[3] On behalf of the seven municipalities of the Western Limfjord, namely Lemvig, Struer, Holstebro, Skive, Vesthimmerland, Morsø, and Thisted.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

1.1 Methodology

According to the RESIST Grant Agreement, the Central Denmark Region (CDR) is listed as the responsible entity for the development and implementation of the three climate adaptation demonstration projects. However, this does not reflect the actual implementation setup. From the outset, the plan has been that the three municipalities – Randers, Lemvig, and Horsens – would each be responsible for developing and implementing their respective projects. Therefore, the reference to CDR in the Grant Agreement is considered a miscommunication.

In practice, CDR has supported the municipalities throughout the process by facilitating coordination, offering guidance, and monitoring progress. CDR has not been directly involved in project implementation but has acted as a regional coordinator among others through the C2C CC project.

For the purposes of this report, CDR collected data through document analysis, desk research, and interviews with municipal representatives from the three involved municipalities. This approach was chosen to ensure a reliable and comprehensive overview of the projects' implementation status and results.

1.1.1 Data collection process

1.1.1.1 Document analysis

Relevant websites, project descriptions, and public consultations were reviewed to gather data on the projects' objectives, processes, and achieved results. This analysis provided a foundational understanding of the context and challenges the projects aim to address.

1.1.1.2 Interviews with municipal representatives

Conversations were conducted with key stakeholders from the three involved municipalities to gather insights into the projects' status, progress, and challenges. These interviews contributed to a more detailed understanding of the practical implementation and the obstacles encountered during the projects.

In total, two interviews were conducted in the autumn of 2024 – one with a representative from Lemvig Municipality and one with a representative from Randers Municipality. The interviews were held online to ensure accessibility for all parties. In the case of Horsens Municipality, information was collected via email correspondences and telephone calls, as scheduling an interview was not feasible due to time constraints. Follow-up emails were sent to all three municipalities to clarify and verify specific details.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

By combining qualitative data from interviews with quantitative data from project descriptions and reports, this methodology provides a solid foundation for a comprehensive evaluation of the three projects and their role in climate adaptation efforts within the CDR.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

2 The Agreement for a Green Denmark (The Green Tripartite Agreement)

The Green Tripartite Agreement is a national accord between the Danish government and key stakeholders, including the Danish Agriculture & Food Council, the Danish Society for Nature Conservation, business organizations, and the Local Government Denmark (Kommunernes Landsforening). The agreement was adopted on 24 June 2024. The purpose of the agreement is to promote a long-term, holistic approach to climate action, water quality, and biodiversity. The agreement supports Denmark's commitments to national and European climate goals, including the EU Water Framework Directive and the EU Biodiversity Strategy (Regeringen 2024).

The Green Tripartite Agreement is relevant to this report, as it addresses the reduction of Greenhouse gas (GHG) emissions and the protection of Denmark's inland marine waters. These initiatives are important for combating oxygen depletion and improving the marine environment – a point particularly emphasized by Lemvig Municipality. The new agreement will further contribute to the climate change adaptation agenda as increases space for natural areas that can be used for water retention and water management.

The agreement comprises the following key elements:

- REDUCTION OF NITROGEN DISCHARGE: Establishment of wetlands and conversion of approximately 140,000 hectares of carbon-rich lowland areas to improve water quality in coastal waters.
- DENMARK'S GREEN LAND FUND: A fund of approximately DKK 40 billion to support the transition to more nature, sustainable land use, and climate adaptation.
- LOCAL IMPLEMENTATION: Creation of catchment area management groups and coastal water councils to ensure local ownership and collaboration in implementing climate initiatives.
- BIODIVERSITY AND CLIMATE RESILIENCE: Enhanced protection of natural areas and strengthening of habitats through afforestation and the designation of untouched natural areas.

The Green Tripartite Agreement is a cornerstone of Denmark's strategy to achieve a 70% reduction in greenhouse gas emissions by 2030 and fosters synergies between environmental protection and climate adaptation. The Green Tripartite Agreement is relevant in relation to the narrowing of the Thyborøn Channel project, as it highlights the increasing national focus on oxygen depletion and the marine environment in the inner Danish waters, including the Limfjord (Regeringen 2024).

The agreement also plays a vital role in the climate adaptation projects in this report by setting requirements for solutions that balance nitrogen reduction, coastal protection, and sustainable land

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

management. The agreement paves the way for a fundamental rethinking of how Denmark's land areas are managed. It also sets out the framework and guiding principles for the measures required to ensure Denmark's compliance with the EU Water Framework Directive, aiming to restore the ecological status of Danish coastal waters. It represents a paradigm shift in nitrogen regulation by combining traditional regulation with targeted land use changes, supported transition measures, and modern land management practices.

The agreement also exemplifies how broad partnerships can ensure the sustainable and effective implementation of EU environmental and climate policy objectives at the national level (Regeringen 2024).

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

3 Project 1: Narrowing of Thyborøn Channel

3.1 Background and purpose

The narrowing of Thyborøn Channel is a climate adaptation project addressing the risks of rising water levels and storm surges for seven municipalities in the western part of the Limfjord: Struer, Holstebro, Skive, Vesthimmerland, Morsø, Thisted, and Lemvig. The combination of sea-level rise and changes in the channel's morphology means that storm surge heights could increase by up to 60 cm within the next 50 years compared to current levels. The objective of the project is to reduce the risk of flooding by narrowing the channel, thereby protecting the coastal areas and surrounding communities in the western Limfjord.

Illustration 1: A narrowing of the entrance to the Limfjord can limit the inflow of water during storms to a level that reduces the risk to the western part of the fjord. The groyne extension is displayed in red, illustrating the planned modifications to Groin 59 and Groin 72.

The narrowing will be achieved by extending the groynes (Groin 59 near Thyborøn and Groin 72 near Agger), limiting the volume of water entering the Limfjord. The extension of the two groynes will leave an opening of 250 metres towards the North Sea. At the same time, the seabed will be fixed at a depth of 13 metres. The 250-metre opening has been chosen as a compromise between ensuring navigational conditions for maritime traffic, providing climate protection for the Limfjord and to ensure an adequate circulation and change of water in the inner fjord (Ramboll 2019b).

Geographical and hydrological context of the Limfjord

The Limfjord is Denmark's largest fjord system, extending approximately 180 kilometres from Thyborøn in the west to Hals in the east (see illustration 2). It comprises a complex network of bays, inlets, and straits, creating a diverse and dynamic marine environment. The fjord connects the North Sea and the Kattegat, effectively separating the North Jutlandic Island from the rest of the Jutland Peninsula (Styrelsen for Grøn Arealomlægning og Vandmiljø n.d.).

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

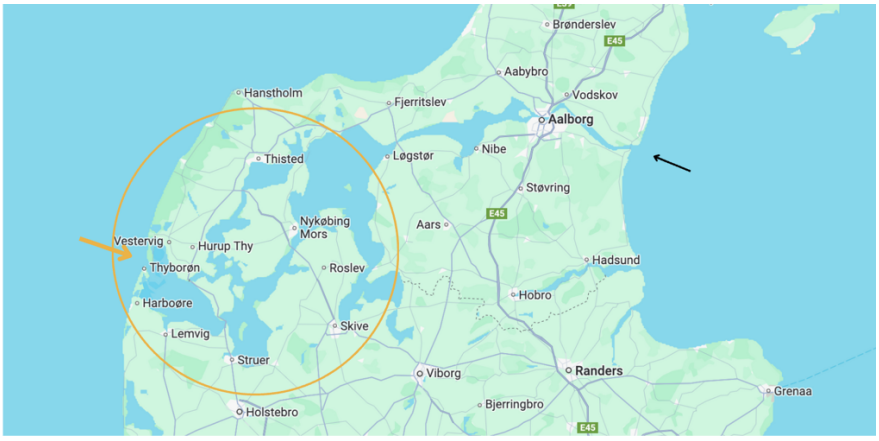


Illustration 2: The image highlights the two inlets to the Limfjord – one from the Kattegat and one from the North Sea – indicating that there is a continuous flow through the fjord. The yellow arrow marks the planned narrowing of the Thyborøn Channel, while the yellow circle outlines the broader project area expected to benefit positively from this intervention.

Hydrologically, the Limfjord functions as an estuarine system influenced by both saline seawater inflows and freshwater discharges. Saline water from the North Sea enters the fjord through the Thyborøn Channel, while freshwater is contributed by several rivers, including the Karup Å system. This mixing results in a west-to-east salinity gradient, with higher salinity levels near the North Sea and lower levels towards the inner fjord areas (Styrelsen for Grøn Arealomlægning og Vandmiljø n.d.).

Therefore, the Limfjord is particularly susceptible to oxygen depletion (hypoxia) in bottom waters during summer months. Hypoxic conditions typically occur during periods of weak or no wind, when oxygen-rich surface water is not mixed downwards. In such conditions, the bottom layers are deprived of oxygen needed to decompose organic material (Styrelsen for Grøn Arealomlægning og Vandmiljø n.d.).

Nutrient enrichment from agricultural runoff and other sources contributes to eutrophication, exacerbating the risk of hypoxia. Efforts to reduce nutrient inputs have led to declines in nitrogen and phosphorus concentrations; however, challenges remain in achieving good ecological status across the fjord system (Schourup-Kristensen, Larsen & Maar 2023).

The Zero Alternative

To assess the effects of narrowing the Thyborøn Channel, it is necessary to compare the proposed intervention with a "zero alternative" – i.e., the scenario that would unfold if no action were taken. For this purpose, the projected situation in 2060 has been used as the reference zero alternative. This includes expected sea level rise, with an estimated increase of 24 cm in the North Sea by 2060.

Compared to the baseline, narrowing the Thyborøn Channel is expected to significantly reduce the 100-year storm surge water levels by 2060. Specifically, storm surge levels would decrease by up to 65 cm in Lemvig and 13 cm in Rønbjerg near Skive (see illustration 2). Most areas in the western Limfjord are located just above sea level (elevation 0), meaning they would be largely inundated by

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

a 65 cm rise in sea level coupled with a storm surge. The larger cities are situated at elevations between 1 and 2 meters, making them particularly vulnerable to rising sea levels and storm surges (illustration 2). However, due to the expected sea level rise, this reduction would only result in lower water levels than today in the areas of Thyborøn and Lemvig. In other regions of the Limfjord, storm surge levels are still projected to increase by up to 15 cm compared to current levels (Ramboll 2019b: 7-10).

By narrowing the Thyborøn Channel, water levels in the Limfjord rise more slowly and to a lesser extent during critical events such as storm surges. Narrowing Thyborøn Channel as a climate adaptation solution for the entire western Limfjord was identified as the most appropriate option among several alternatives in a 2012 report by the Danish Coastal Authority (Kystdirektoratet 2012: 25–27).

3.2 Project development

The project is divided into four subprojects:

1. Comprehensive mapping of the area.
2. Development of collaboration models with emergency management authorities.
3. Exploration of financing opportunities.
4. Preliminary design planning for the project area.

This project was one of the subprojects under C2C CC, supported by the EU LIFE program over six years (2017–2022).

Work was carried out in partnership with seven municipalities (Struer, Holstebro, Skive, Vesthimmerland, Thisted, Morsø, and Lemvig) and seven water utilities, with input from relevant stakeholders. Lemvig Municipality acts as the project lead.

In November 2024, a two-year collaboration agreement was established between the seven municipalities and the Danish Coastal Authority to further develop the project. This is part of the *"State Engagement under the Government's Climate Adaptation Plan 1"* introduced in October 2023, with Lemvig Municipality continuing as the lead. There is support for the implementation of the project; however, as the financing has not yet been secured, it is difficult to confirm whether the project will ultimately be carried out. The estimated cost of DKK 700 million is considerable and far exceeds what Danish municipalities can finance alone or collectively. As a result, the project is currently dependent on obtaining external funding before it can be realised.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

3.3 Results and status

Studies conducted indicate that narrowing the channel to an opening of approximately 250 meters would ensure that storm surge levels over the next 50 years remain consistent with those currently experienced and manageable. This approach provides additional time to evaluate which long-term climate adaptation solutions are most appropriate. Socioeconomic assessments suggest that damages from just one 100-year storm could cover the construction costs, estimated at approximately DKK 700 million (Rambøll 2019b: 17).

The environmental impacts on the fjord's aquatic system have been assessed. Particular attention has been given to ensuring sufficient water exchange to prevent hypoxic conditions. This consideration has directly informed the proposed spacing between the groynes (Rambøll 2022).

In the collaboration between the seven municipalities and the Danish Coastal Authority, further attention will be given to assessing environmental impacts and exploring potential financing models. Additionally, it remains unclear whether the responsibility for project implementation will lie with the municipality(ies), the state, or both. The Limfjord is designated as a flood risk area under the EU Floods Directive, necessitating the development of a comprehensive action plan, which will be incorporated into the partnership's work.

A key condition for the project's progress is the ability to secure support from relevant stakeholders, particularly given the project's inherent dilemmas. While the goal is to prevent flooding, this must not come at the expense of the fjord's water quality, and the project must remain financially feasible. The Green Tripartite Agreement is expected to influence the project due to the significant nutrient discharge levels in the Limfjord.

However, there is no concrete plans for implementation as a model and plan for financing the project still needs to be settled. This is continuously being debated between the involved municipalities. At the same time the initial steps of the Green Tripartite Agreement are being conducted which will contribute to the project.

3.3.1 Local adaptation measures or a joint solution?

In 2024, the western Limfjord area was officially designated as a flood risk area under the EU Floods Directive. This designation places a responsibility on the seven municipalities - Struer, Holstebro, Skive, Vesthimmerland, Morsø, Thisted, and Lemvig - to develop risk management plans and assess the most effective means of protecting their coastal areas.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

A key consideration is whether to prioritize a coordinated large-scale solution, such as the proposed narrowing of Thyborøn Channel, or to focus on localized adaptation measures tailored to individual municipalities.

Recent assessments within the project partnership indicate that implementing local adaptation measures - such as coastal dikes - will not negatively impact the potential future realization of the large-scale narrowing project. On the contrary, such measures may extend the lifespan of a future channel narrowing by reducing immediate flood risks while awaiting broader political and financial alignment.

This dual-track approach aligns with Dynamic Adaptive Policy Pathways (DAPP) principles, ensuring that short-term measures contribute to long-term climate resilience, regardless of whether the large-scale solution is ultimately implemented. The ongoing assessment of local versus joint solutions remains a focal point in the municipalities' strategic planning.

Socio-economic benefits of narrowing the Thyborøn Channel
Calculations indicate that a joint solution involving the narrowing of the Thyborøn Channel offers considerable socio-economic benefits. Future storm surges are expected to occur more frequently and with greater intensity, causing more extensive damage to people, nature, buildings, and infra-structure. Analyses suggest that narrowing the channel could result in savings of up to DKK 900 million from just a single severe storm surge event. The actual economic benefit will depend on how many storm surges occur and whether the construction is completed before the next major event. While the impact of storm surges varies from one municipality to another, all involved municipalities are expected to benefit from a reduction in high-water levels compared to a “do-nothing” scenario (Johnsen 2021: 16 – 23).

In addition, large areas of the western Limfjord are designated Natura 2000 sites and include §3-protected nature, such as coastal meadows, which are particularly vulnerable to prolonged flooding. By dividing the construction into phases, sufficient water exchange can be maintained throughout the process, helping to ensure that environmental impacts remain at an acceptable level (Johnsen 2021: 16 – 23).

3.4 Key lessons and barriers

During the project’s development, several important lessons and challenges have been identified:

- ENVIRONMENTAL IMPACTS: Potential effects on the local ecosystem require further investigation. This includes assessing how the narrowing of the channel will affect the water quality in the Limfjord, particularly regarding oxygen depletion. A final

Co-funded by the European Union
Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Environmental Impact Assessment (EIA) has yet to be completed, but there is significant focus on safeguarding the water quality of the Limfjord.

- FINANCING CHALLENGES: Securing adequate funding for the full implementation of the project remains a challenge. The total cost is estimated at DKK 700 million, which presents a financial burden for the involved municipalities. The partnership is currently exploring potential national and European funding sources. For example, Lemvig Municipality participated in a meeting with the European Investment Bank in the spring of 2024 to discuss potential financial support for the project.
- CLIMATE ADAPTATION BENEFITS: The project's primary value lies in its climate adaptation potential. By reducing the risk and severity of future storm surges, the narrowing of Thyborøn Channel can help prevent substantial damage to people, nature, buildings, and infrastructure. As highlighted in recent analyses, the socio-economic gains could exceed the project's estimated cost of DKK 700 million – potentially saving up to DKK 900 million in damages from a single extreme storm event.
- CROSS-MUNICIPAL COOPERATION: A key achievement of the project has been the successful establishment of a cross-municipal partnership. All seven municipalities around the Limfjord have joined forces with the Danish Coastal Authority to develop a shared climate adaptation solution. This collaboration strengthens regional capacity, aligns local efforts, and sets a strong example of coordinated climate action.

3.5 Future perspectives

This project represents a critical step in climate adaptation for the western Limfjord. Through continued collaboration among partners and a focus on balancing technical, environmental, and socioeconomic considerations, the project is expected to yield valuable insights for future climate adaptation initiatives in Denmark and the EU.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

4 Project 2: The Climate ribbon in Randers

4.1 Background and purpose

Initiated under the C2C CC project, the Climate Ribbon is a visionary climate adaptation initiative spanning more than 6 km along the Gudenå River and Randers Fjord. It is a central component of Randers Municipality's strategic urban development plan, *Flodbyen Randers*. The project aims to protect the city from storm surges and heavy rainfall while creating new opportunities for urban life and recreational experiences near the water.

The project integrates technical climate adaptation solutions with urban revitalization, transforming water into a resource rather than a threat. Its foundation lies in a multifunctional approach where climate adaptation, nature-based solutions, and urban development work in harmony. Collaboration between the municipality, architects, citizens, and investors has been critical to ensuring the project's relevance and impact. The partnership consists of Randers Municipality, AP Pension, and C.F. Møller Architects, along with Orbicon, De Urbanisten BV, Gemeinschaft A/S, Sadolin & Albæk A/S, NIRAS, Witteveen+Bos, 2+1 ApS Idebureau, and Mette Bjærge. AP Pension is a significant partner, contributing to the project's realization through their involvement in land development and investments in Flodbyen Randers.

Illustration: Randers Kommune 2020 (Randers Municipality 2020)

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

4.2 Key components of the Climate Ribbon

1. THE CLIMATE BRIDGE: A new bridge over the fjord that functions as both flood protection and improved traffic infrastructure. It includes a bridge over the fjord, a dam across the northern harbour basin, and new road connections on both sides. The project has a total budget of DKK 559 million, with DKK 3.5 million allocated by Randers City Council for supplementary studies (Flodbyen Randers 2024; Trans 2024; Randers Municipality 2024a). The bridge is currently under development and undergoing political review, and the final design has yet to be determined.
2. A GREEN BELT (FLOOD PROTECTION): Refers to a continuous stretch of green areas integrated into the Climate Ribbon along Randers Fjord and the Gudenå River. These areas include parks, recreational facilities, and natural landscapes that serve not only as flood protection against storm surges and rising water levels, but also as recreational and aesthetic elements in the urban environment. The name "Green Belt" reflects this combination of functional climate adaptation and green urban development.
3. RECREATIONAL AREAS: Development of new urban spaces and natural areas along the water, such as a river bath, delta promenade, and tidal park, to enhance urban life and improve access to the water.
4. PATHWAY CONNECTIONS: Establishment of interconnected pedestrian and bicycle routes along the water to connect the city centre with surrounding natural areas and promote sustainable transportation.
5. URBAN DEVELOPMENT: Climate adaptation is integrated into future urban development areas, where new buildings and public spaces are planned with a strong focus on climate resilience and sustainability. Two central elements in this transformation are Justesens Plæne and the newly established harbour bath (Flodbadet). Justesens Plæne is being developed into an attractive urban green space that invites recreation and public life along the waterfront. Combined with Flodbadet – which offers direct access to water-based activities in the heart of the city – these spaces contribute to making Flodbyen Randers a vibrant and climate-resilient urban district.

The Climate Ribbon combines technical flood protection measures with recreational and urban development initiatives, strengthening the connection between Randers, its waterways, and the surrounding natural environment. It is considered a sustainable, long-term solution addressing multiple complex challenges simultaneously.

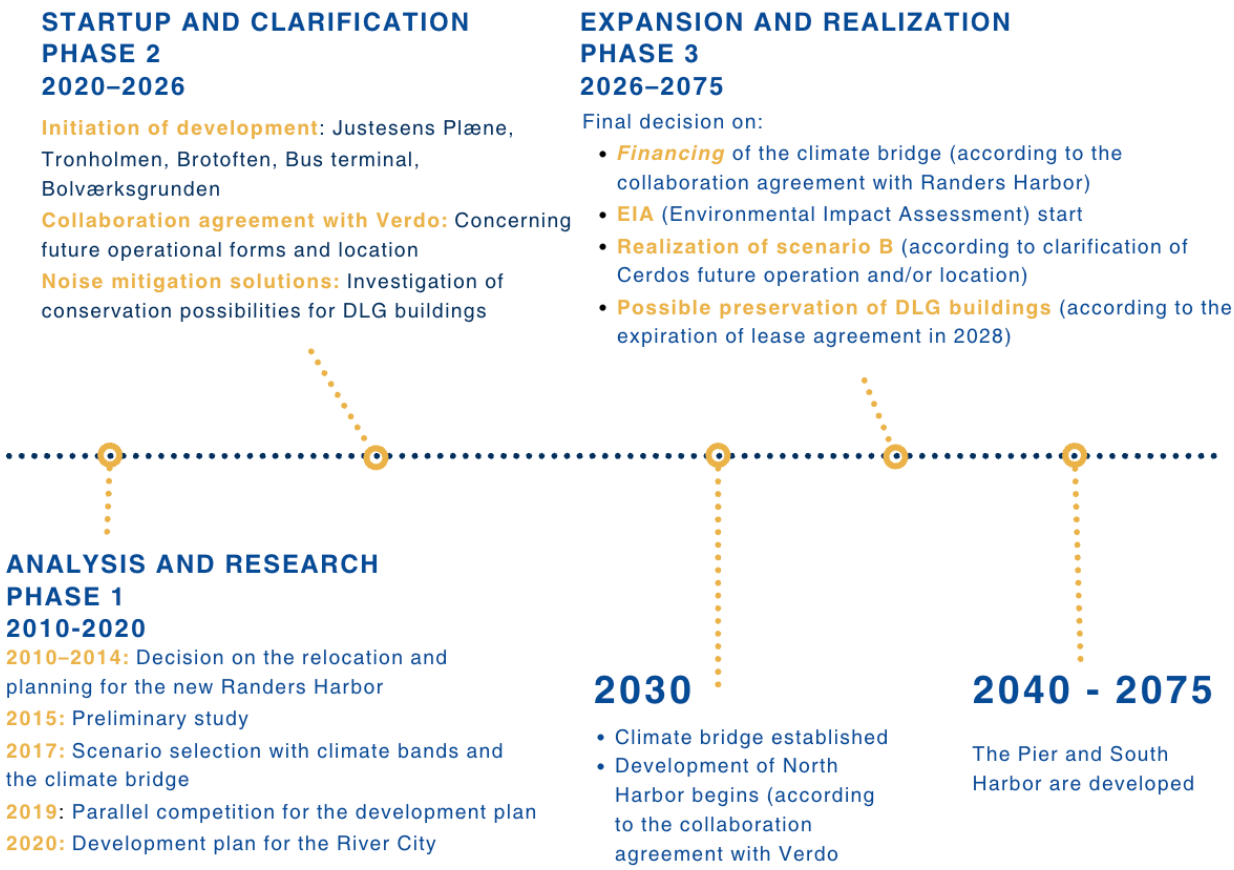
4.3 Project development

While there is no single official start date, planning for the Climate Ribbon began in 2015 and will continue until 2075. Implementation of the various components is expected to extend beyond 2030. The project is primarily driven by Randers Municipality's long-term urban development strategy and local climate adaptation goals. The development, financing, and implementation of the Climate Ribbon will be carried out in several phases which are illustrated in the timeline below.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Due to its scale and complexity, the full realisation of the Climate Ribbon falls outside the timeframe of the RESIST project.



The timeline provides an overview of the project's estimated phases and milestones. While the dates remain indicative, it illustrates the project's ambitious long-term vision. The timeline is based on Flodbyen Randers' official project schedule.

4.4 Results and status

The Climate Ribbon will deliver comprehensive flood protection for Randers' city centre on both the north and south sides of the fjord. The project has created new recreational areas that enhance urban life and strengthen the connection between the city and its waterways. Additionally, it has raised awareness about climate adaptation among the city's citizens and stakeholders.

The status of the five main components is as follows:

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

1. THE CLIMATE BRIDGE: As of October 28, 2024, the City Council decided to initiate supplementary studies on road layouts, pathway connections, and potential scenarios for the marina. Planning continues, but the bridge is delayed due to political and financial challenges, with completion expected no earlier than 2030 (Randers kommune 2024b).
2. THE GREEN BELT: Designed to protect Randers from storm surges, this component includes flood protection measures from the Climate Bridge in the east to Justesens Plæne in the west, as well as on the fjord's south side (Randers kommune 2024c).
3. RECREATIONAL AREAS: Plans for developing urban spaces such as a river bath and tidal park are part of the broader Flodbyen Randers vision. However, implementation awaits completion of essential flood protection measures (Randers kommune 2020).
4. PATHWAY CONNECTIONS: Interconnected pedestrian and bicycle routes are planned as part of the Climate Ribbon, linking the city centre to surrounding natural areas. Detailed planning and implementation are ongoing (Randers kommune 2024c).
5. URBAN DEVELOPMENT: The Climate Ribbon forms the backbone of future urban development, where climate adaptation is integrated into building and public space design. Implementation depends on the completion of infrastructure projects such as the Climate Bridge (Randers kommune 2024c).

The Climate Ribbon is currently in an advanced planning phase, with several main components under detailed study. Full implementation is expected to span several years.

4.5 Lessons learned and barriers

Throughout the project, several critical insights have emerged:

- PUBLIC ENGAGEMENT: Early and ongoing involvement of local stakeholders is vital to the project's success and ensures that solutions reflect community needs and aspirations.
- FINANCING: Securing sufficient funding for full implementation remains a challenge, highlighting the need for diversified funding sources, including public-private partnerships.

Overall, the Climate Ribbon in Randers demonstrates how climate adaptation can be seamlessly integrated into urban development to protect against future climate challenges while enriching the city's recreational and aesthetic qualities.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

5 Project 3: Dike and embarkment project in Horsens

In relation to the dike and embankment project in Horsens Municipality, there has been a dialogue with the municipality. Based on this dialogue, it has been informed that the project is currently on hold due to several factors. This reflects the status that can be reported to the EU[4].

[4] Due to the sensitive nature of this project, further details cannot be disclosed in this public deliverable.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

6 Summary and key learnings

The three climate adaptation projects in Region Midtjylland—1) the narrowing of Thyborøn Channel, 2) the Climate Ribbon in Randers, and 3) the temporarily paused dike and embarkment project in Horsens – demonstrate diverse approaches to addressing complex climate challenges. Despite their differences in objectives, challenges, and implementation, the projects share several common features that can inform future climate adaptation initiatives:

- HOLISTIC APPROACH: All projects highlight the importance of combining technical solutions with sustainable urban development and nature-based solutions to ensure that climate adaptation addresses not only immediate risks but also creates long-term societal value.
- COLLABORATION AND PARTNERSHIPS: The success of the projects has depended on collaboration between municipalities, state authorities, private actors (such as AP Pension in Randers), and local citizens. Early engagement and coordination have strengthened the relevance and feasibility of the projects.
- FINANCING CHALLENGES: Securing funding has been a recurring theme across the projects. For example, the partners behind the Thyborøn Channel project have worked to attract national and European funding, while the Randers project has benefited from partnerships with private investors such as AP Pension.
- ENVIRONMENTAL CONSIDERATIONS: The projects have highlighted the need for thorough environmental assessments. A balanced approach between technical objectives and environmental protection is essential to ensure sustainability.

6.1 Evaluation of results and potential

- THYBORØN CHANNEL: The project is still in its early stages but has the potential to significantly reduce the flood risk in the Limfjord. However, challenges related to environmental impacts and financing require further solutions.
- THE CLIMATE RIBBON IN RANDERS: This project is considered a model example of how climate adaptation can be integrated with urban development, recreational areas, and private investments. It demonstrates how visionary partnerships can create comprehensive solutions.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

7 Conclusion

The evaluation highlights that climate adaptation projects require a flexible, collaborative, and long-term approach. The experiences from the three projects underscore the importance of balancing technical, social, and environmental considerations to create sustainable and effective solutions. These lessons can be used to strengthen future climate adaptation initiatives both in Central Denmark Region and across Europe.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

8 References

Environmental Protection Agency. (n.d.). *The Limfjord*. Retrieved from https://sgavmst.dk/natur-og-jagt/naturen-i-danmark/novana-overvaagning-af-natur-og-vandmiljoe/guider-til-danske-vandomraader/marin/limfjorden

Flodbyen Randers. (2024). "Flodbyen Randers – Officiel hjemmeside." Flodbyen Randers. Retrived form https://flodbyenranders.dk/.

Horsens Kommune. (2022). "Klima." Forudsætningsredegørelse 2022. https://forudsaetnings-redegoerelse2022.horsens.dk/klima/

Lemvig kommune. (2023). “Klimatilpasningsplan 2023”. https://www.lemvig.dk/Files/Files/Teknik%20og%20Milj%C3%B8/Planer/Klimatilpasning-splan/Klimatilpasningsplan%202023_Endelig%20til%20KB.pdf

Johnsen, Rasmus. (2021). “Åbningen mod Vest: Indsnævringen af Thyborøn Kanal som værn mod stormfloder I den vestlige Limfjord”. Rambøll. Coast to Coast Climate Challenge. C9 – Thyborøn Kanal & Vestlig Limfjord. November 2021. https://www.c2ccc.eu/siteassets/c2ccc/falles-mate-riale/danske-foldere/pixi-udgave-a5_sla.pdf.

Kystdirektoratet. (2012). "Thyborøn Kanal og den vestlige Limfjord – Analyser af mu-lige tiltag til reduktion af oversvømmelsesrisiko". https://kyst.dk/media/aaehqduf/thyboroenkanalogdenvestli-gelimfjord.pdf.

Rambøll. (2019a). “Thyborøn Kanal og Vestlige Limfjord Del 1: VVM-lignende Redegørelse og In-teressentanalyse”. https://www.c2ccc.eu/siteassets/c2ccc/delprojekterne/aben-land-projekter/c9-thyboron-kanal-og-vestlige-limfjord/c9.1-vvm-lignende-redegorelse-og-interessentanalyse.pdf.

Rambøll. (2019b). “Thyborøn Kanal og Vestlige Limfjord. Ikke-Teknisk Resumé”. Coast to Coast Climate Challenge. https://www.c2ccc.eu/siteassets/c2ccc/produkter/ikke-teknisk-resume---pixi.pdf

Rambøll. (2022). “Kysterosion Bidrag til Klimatilpasningsplan”. Til Lemvig kommune. https://www.lemvig.dk/Files/Files/Teknik%20og%20Milj%C3%B8/Planer/Klimatilpasning-splan/Bilag%202%20-%20Kysterosion%20-%20Lemvig%20Kommune.pdf.

Randers Kommune (2020). "Udviklingsplan for Flodbyen Randers: Byen til Vandet". Randers Kom-mune. https://www.randers.dk/media/1g2gohra/udviklingsplan-for-flodbyen-randers-komprimeret-was.pdf.

Randers Kommune. (2024a). "Efter debat om Klimabroen: Flere detaljer skal undersøges." Rand-ers Kommune. Status og videre proces - Randers Kommune

Randers Kommune. (2024b). "Status og videre proces". Randers Kommune. Status og videre pro-ces - Randers Kommune. https://www.randers.dk/udvikling-by-og-land/byer-og-lokalsamfund/strat-egisk-udvikling-af-byer-og-omraader/klimabroen/status-og-videre-proces/.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Randers Kommune. (2024c). "Klimabåndet – Klimatilpasning af Randers By." Randers Kommune. Klimabåndet - klimatilpasning af Randers by - Randers Kommune

Regeringen. (2024). “Aftale om et Grønt Danmark”. https://regeringen.dk/aktuelt/publikationer-og-aftaletekster/aftale-om-et-groent-danmark/.

Schourup-Kristensen, Vibe, Larsen, Janus & Maar, Marie. (2023). "Drivers of hypoxia variability in a shallow and eutrophicated semi-enclosed fjord”. Marine Pollution Bulletin. Vol. 188, March 2023. DOI: https://doi.org/10.1016/j.marpolbul.2023.114621.

Styrelsen for Grøn Arealomlægning og Vandmiljø. (n.d.). The Limfjord. https://sgavmst.dk/natur-og-jagt/naturen-i-danmark/novana-overvaagning-af-natur-og-vandmiljoe/guider-til-danske-vandomraader/marin/limfjorden

Trans, Jeppe. (2024). "Ideerne til Klimabroen er væltet ind fra borgerne: Nu vil kommunen gå videre med flere af forslagene." Amtsavisen. https://amtsavisen.dk/randers/ideerne-til-klimabroen-er-vaeltet-ind-fra-borgerne-nu-vil-kommunen-gaa-videre-med-flere-af-forslagene.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.