



C2C CC



COAST TO COAST CLIMATE CHALLENGE **MIDTERM STATUS**

C2C CC

COAST TO COAST CLIMATE CHALLENGE

In Denmark, the thought about climate changes is not new. We have talked about the climate for decades and we know what the major increase in global temperatures will mean to us. We have already begun to see many of the changes. In Denmark, the climate changes will lead to larger amounts of rain than we have been used to. Already now, we see more and heavier rain all over the country.

Residential areas have problems draining off the water, big and small streams overflow, agricultural fields are flooded and communities along the coast and fjords are hit more often by heavy storms and flooding. At the same time, sea and groundwater levels are rising.

All of the 98 municipalities in Denmark will somehow have to manage increasing amounts of water. The specific climate problems differ from one geographical area to the other, but the challenge is basically the same. Climate problems are, however, heavy burdens to lift locally. Water knows no boundaries and it makes sense to solve the problems in collaborations across municipality and city limits – and across professional boundaries.

Since January 2017, the Coast to Coast Climate Challenge (C2C CC) has gathered all municipalities in Central Denmark Region in an ambitious climate project, which will strengthen the region when meeting future climate challenges. The EU funded project works with innovative solutions to protect city and rural areas to create higher value for citizens.

The C2C CC connects the majority of the municipalities in Central Denmark Region and help them

collaborate with each other, with local supply companies, private companies and knowledge institutions collecting and analysing new knowledge and data on climate issues.

The Coast to Coast Climate Challenge consists of 24 sub-projects on sea, fjord, streams, rainwater and groundwater as well as governance, tools and innovation. We are halfway through the project period and the majority all of the 24 sub-projects are ongoing and some have already reached their goal. This report is a status of the progress of all 24 sub-projects as well as plans until the project is concluded in December 2022.

The C2C CC project is supported by the EU LIFE programme with DKK 52 million.

The project runs from January 2017 to December 2022 and is a collaboration between 31 partners and 25 supportive stakeholders. Other stakeholders will continuously join during the project period.

The 31 partners are primarily municipalities in Central Denmark Region, local supply companies and universities.



Scan to watch interview about C8

C8

HÅB TO HÅB – HEDENSTED MUNICIPALITY

The area between Glud Håb and Håbet south of Horsens Fjord is a beautiful and attractive natural resort. Originally, the area consisted of sea and islands, but the area has since been embanked. Today, the area is pressured by increasing amounts of water from both the sea and two stream systems; following a long period with heavy rain, the amount of water is already now breaking all records.

This is a huge challenge to farmers, summer cottage owners, permanent residents and companies. Moreover, it limits use of the natural resort for spare time activities. Hedensted Municipality has initiated the Coast to Coast Climate Challenge project Håb to Håb, gathering all stakeholders in the area to find common solutions to the climate problems caused by the water from both the sea and the hinterland now and in the future.

The area from Glud Håb to Håbet is in many ways a historical area and it was thus obvious for Hedensted Municipality to collaborate with Moesgaard Museum to benefit from the knowledge the museum has gained through the sub-project C24, Climate history | Cultural history. In sub-project C24, Moesgaard Museum and Aarhus University have studied the association between local identity and historical narratives, and how to use this association to engage citizens in climate adaptations in the local area.

In collaboration with Moesgaard Museum and several local museums, Hedensted Municipality started making a cultural history description of the area. They invited selected stakeholders and open groups to walk the fields and participate in bus trips where museum staff and nature guides told about the history of the area. The stakeholders

who broadly represent the area from Glud Håb to Håbet have the opportunity to tell their own story and share perceptions of the problems they encounter in the area.

Inspired by the Dutch tool 3Di, Hedensted Municipality has developed a hydraulic model visualising how rain and sea water run through the landscape. The municipality presented this visualisation at a meeting also providing a broad description of the area. The many different stakeholders from the area had the opportunity to tell how this description and the visualisation of the water are consistent with their reality. Do they see the water collecting at the same places?

Stakeholders were invited to suggest solutions to be incorporated into the model. This process was supported by Aalborg University, which together with the other partners developed a method to identify possible added value and include this in solutions.

By connecting the suggested solutions to the technical model, it is possible for the municipality to assess which suggestions may be implemented.

In this sub-project, Hedensted Municipality has attached great importance to listen to citizens' suggestions and find solutions that would create added value. It is important to stakeholders in the local community to benefit from the climate adaptation. Nature must be valuable for the local citizens and possible solutions should not only be focused on attracting more tourists to the area.



Scan to watch interview about C9

C9

THYBORØN CHANNEL AND THE WESTERN LIMFJORD

The area around the western Limfjord is one of the most vulnerable areas in Denmark when it comes to climate changes. In heavy storms, the area around the Limfjord is threatened by flooding and in the surrounding towns the water level may be two meters above the normal level in rough weather. This will probably only be worse in the future with increasing sea levels, frequent heavy rain and storms.

Sub-project C9 is a collaboration between the seven municipalities around the Limfjord and municipal water supply companies trying to find common solutions to the climate changes in the area now and in the future. In addition to working across municipal borders, the sub-project also stretches into North Denmark Region where three of the seven municipalities are located.

In the first phase, the 14 partners in collaboration with the consultancy Rambøll have mapped the effect on the water level of narrowing the channel between Thyborøn and Agger. This has also provided an overview of the consequences for the environment and the nature of the western Limfjord.

If the sea level increases by 24 centimetre as expected up until 2060, more water from the North Sea will be pressured into the Limfjord during storm surges. By extending the two groynes in Thyborøn and Agger, the channel will be reduced to an opening of 250 meters. If the project is completed, the water level in the Limfjord will not exceed two meters up until 2060. If the municipalities do not do anything to keep down the water

level the fjord, the surrounding towns will be exposed to heavy flooding in the future.

So far, the sub-project has been very focused on model calculations and simulations of the effect of narrowing the Thyborøn Channel. The next step will be to launch and not least finance the solution. The narrowing of Thyborøn Channel will amount to DKK 700 million and in the next phase of the project, different financing models will be investigated. It may be necessary to consider differentiated payment if the effect of the narrowing is not similar in all of the seven municipalities. Seemingly, the solution will not have an equally beneficial effect in Løgstør as in e.g. Lemvig and Thyborøn. In most areas, the water level up until 2060 can be maintained at the same level as today; this may, however, only be possible until 2050 in Løgstør. The 14 municipalities and supply companies hope the government and other investors find it valuable to contribute to the project. This is one of the tasks they start to look into now.

The next big step in the next project phase is to put out the tender. The partners must find an engineering company, but they are also looking for landscape architects to participate in the project. Instead of just putting stones into the water, which is the traditional solution, the municipalities hope that the construction can create added value for the citizens and tourists in the area.



Scan to watch interview about C10

C10

THE GRENAA STREAM AND HINTERLAND

The Grenaa Stream is seven kilometres long and runs through the area of Djursland and Grenaa and flows into the Kattegat. Every day, the stream leads large amounts of water from the 466 square kilometres of hinterland into the sea. In storms, the water from the Kattegat is pressured into the Grenaa Stream, the water in the stream cannot flow out and Grenaa risks being flooded.

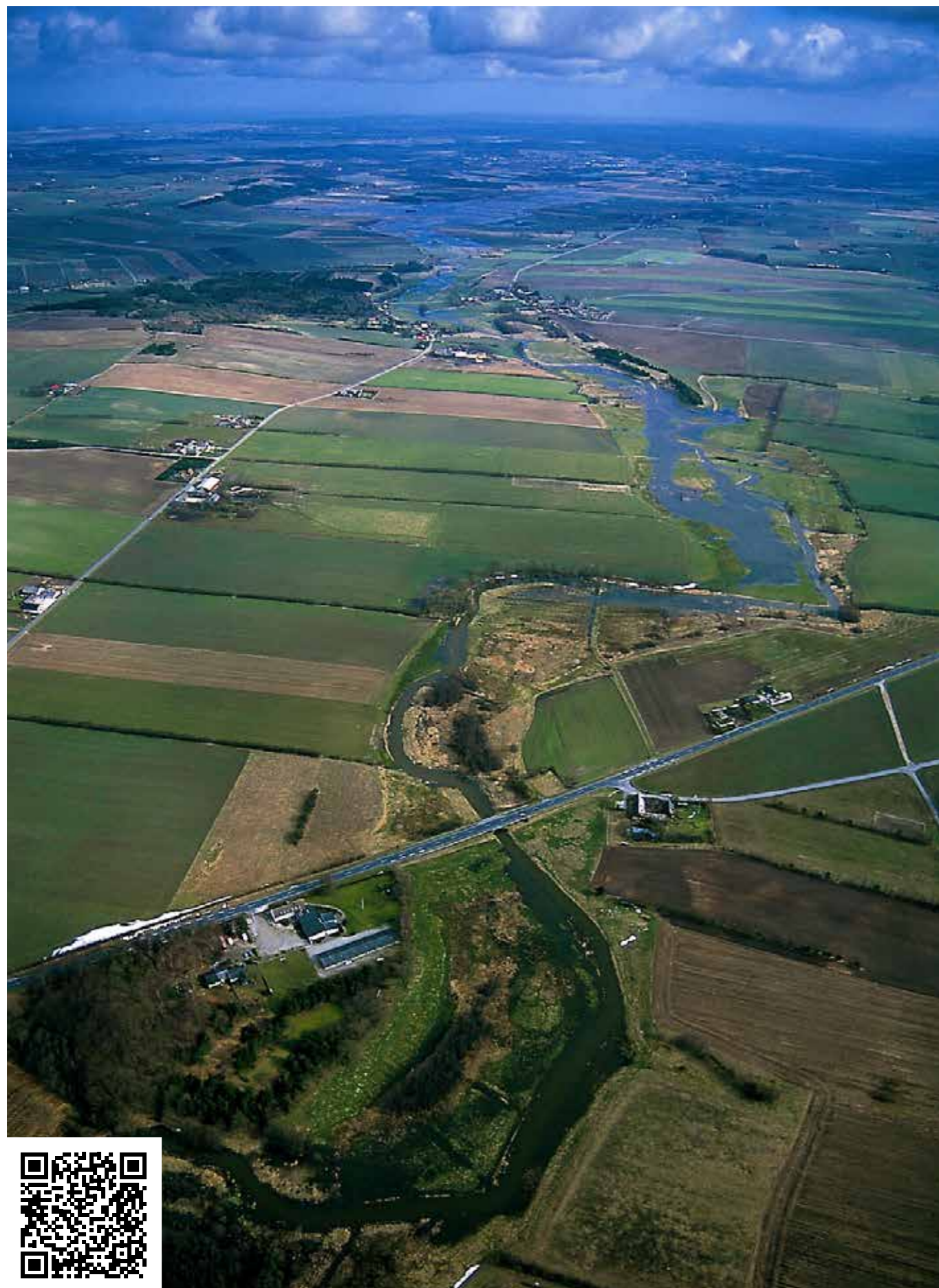
This causes problems with sea water on the one hand and inland water such as rainwater, watercourses, ground water and surface water on the other hand. The larger hinterland of the Grenaa Stream stretches through Norddjurs Municipality and Syddjurs Municipality. Thus, these two municipalities have been collaborating on water issues across municipal borders for a long time. Also, in the Coast to Coast Climate Challenge sub-project 10, the two municipalities are partners.

In this area, there are many interests to consider when municipalities make climate adaptations. There are several landowners already organised in drainage associations, wastewater companies discharging rainwater from the hinterland and the municipality as the authority maintaining the many small watercourses. Moreover, there are cultural interests, outdoor activity organisations, ornithologists, anglers etc. Last but not least, farmers cultivating the areas of the previous Kolindsund, which have been drained to create cultivation areas. The aim of the two municipalities is to involve all stakeholders in the hinterland to find solutions to the climate changes threatening the area.

To get an idea of the location of the problems, Norddjurs Municipality and Syddjurs Municipality

have worked with several hydraulic models. It has been a huge task to gather all the different professions with expertise in specific areas such as drinking water or watercourses. The different calculation models are combined to give as precise a picture as possible of the reality. In the first phases of the sub-projects, the municipalities have come closer to finding a useful model. Now they will investigate in which areas the model is correct and areas where more efforts are needed. For instance, the municipalities discuss the model with a group of stakeholders who can tell if the calculations match their reality. It has been important to the two municipalities to keep the project as open as possible, and the advisory board is not a closed group. Everybody can contribute when the group discusses how climate changes affect the area.

When the model starts to fit the reality according to the stakeholders, the next step is to set up some scenarios picturing the future climate changes. The large amounts of water must be stored somewhere when the stream is under pressure. By applying their knowledge to a useful model, the municipalities can e.g. see where flooding would be adequate and where the water should definitely not go. Based on the technical models and contributions from the many stakeholders, Norddjurs Municipality and Syddjurs Municipality are ready to take the next step of drafting an overall plan for managing water challenges in the future.



Scan to watch interview about C11

C11

THE RANDERS FJORD

When hurricane Bodil hit Denmark in December 2013, the entire area around Alling Stream in Allingåbro was flooded. According to Norddjurs Municipality, the storm was the best-case scenario considering what climate changes may bring in the future. Hurricane Bodil was a taste of what can be expected.

Alling Stream is one of the project areas located in the eastern part of the Coast to Coast Climate Challenge sub-project C11. When sea water flows into the Randers Fjord, it is difficult for the stream to press out the water, which is a huge challenge to urban and large rural parts of the area. Water threatens both smaller towns around Alling Stream and the fjord as well as the city of Randers, risking considerable loss of values. The area is already mentioned in the EU Floods Directive as one of the particularly threatened flooding areas in Denmark. Randers Municipality and Norddjurs Municipality have collaborated on climate proofing the areas for years, and it was thus obvious that the two municipalities became partners in a Coast to Coast Climate Challenge project. As a part of this project, the municipalities have received some calculation models showing how the sea water will flood large areas around the Randers Fjord. The models make it possible for the two municipalities to plan how they together can prevent flooding of the area.

The municipalities keep an open process on how to make climate adaptation. They now have useful models and the next project phase will be to continue working with these models. They have e.g. brought an advisor onboard to set up different scenarios. What will happen if they e.g. close a drainage association or relocate some of the

dikes? How will the water balance be affected by building a lock at Udbyhøj? Can the different scenarios contribute to the climate adaptation in the area? The municipalities have not decided on a specific solution yet. First, they move on to the next phase of the project focusing on including pumping stations, politicians and the citizens affected by the flooding.

As the first part of the project has been very theoretical, it has been important for the municipalities to involve the different stakeholders when the models started to show something specific.

Problems become far more realistic when e.g. the chairmen of the local drainage associations look at a map and see for themselves how the large amounts of water will affect them in the future.

Being a part of the Coast to Coast Climate Challenge project, it has been possible to connect C11 to other sub-projects in the region, such as C16 on the Randers Climate Ribbon and C12 on the Gudenå River. Together the municipalities have divided the project into stages deciding which problems to solve first and which should be solved later. It is also possible to see a combination of the projects where Randers Municipality and the Climate Ribbon already manage a part of the water in the fjord to relieve the pressure in the other parts of the area. Due to the collaboration in the Gudenå River project, the municipalities can share their calculation models and obtain a far more realistic picture of the climate challenges they are faced with in the future.



Scan to watch interview about C12

C12

THE GUDENÅ RIVER

The sub-project on the Gudenå River is a collaboration between seven municipalities along the Gudenå River and Skanderborg Utility Company. To begin with, the size of the Gudenå River is a problem in the area. The extreme flooding caused by large amounts of rain in 2019 and 2020 have made it obvious that the area needs climate adaptation. To make this adaptation, the municipalities need to collaborate closely and develop an understanding of how to manage the water in the Gudenå River together. To prevent or manage flooding is not a task for the individual municipality alone.

The major flooding caused by the Gudenå River affects the many stakeholders in the area – residents living close to the river, farmers cultivating the land along the river and the many others who use this unique area for recreational activities. Moreover, the flooding damages roads, path systems and nature areas. Although it is natural that the landscape changes because of water, there is also a risk that major natural values will be lost.

In the first part of the project, the municipalities have collaborated with Danish Hydraulic Institute (DHI). The DHI has made a calculation model for the Gudenå River which includes eight different scenarios describing the effect of a number of climate adaptation solutions. Many in the area have been interested in finding out the effect of weed cutting in the river on the water level. Another scenario is to find out the effect of sand mining in the river. Applying the model, the municipalities have been able to map out as well as make risk and value assessments for all areas around the river. In this way they can find out which areas to protect and which should be exempt from e.g.

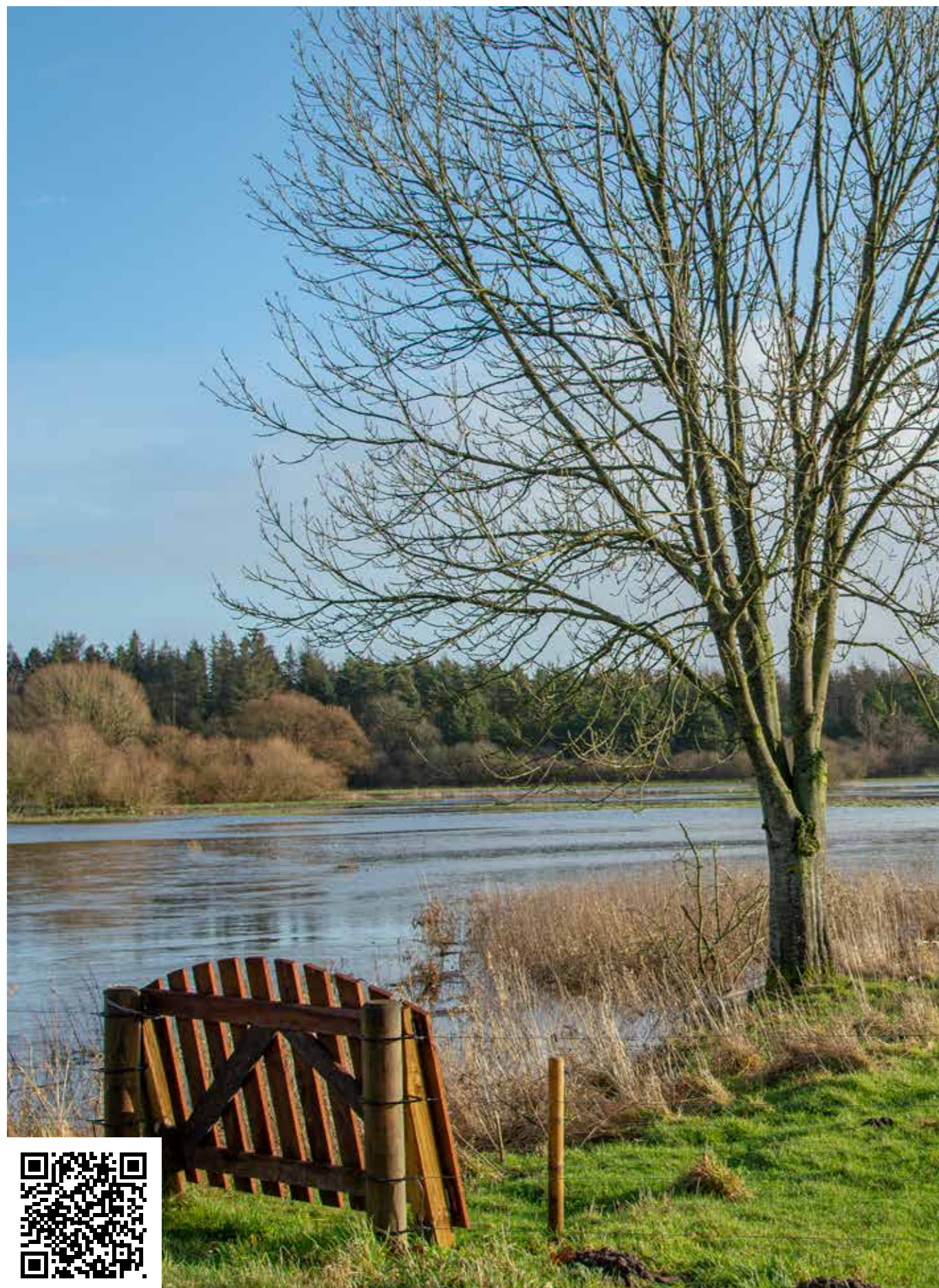
agricultural activities. The model can also show how useful the solutions are and if they are cost effective.

The Gudenå River model has an integrated notification system informing residents and users about the current water level; the model can also predict if the water level will increase. The notification system can tell where the water will spread in the landscape; this is information the landowners along the river are really curious about.

By visualising problems and possible solutions, the stakeholders in the area find it easier to relate to the problems and to be involved in finding solutions to the climate challenges.

The next step in the project is to introduce the final model to citizens and users and to make an overall plan for the area in collaboration with authorities.

In February 2020, the area north of Silkeborg was flooded and Svostrup Inn became known nationwide because it was drowning in water. This spurred the interest in finding efficient solutions to the problems among local politicians and at national level. The huge challenge is now to make a plan together to solve the problems and make it safe for the neighbours and users of the Gudenå River.



Scan to watch interview about C13

C13

THE RIVER STORÅ

When Central Denmark Region approached Herning Municipality and invited them to participate in the Coast to Coast Climate Challenge project, the Storå River had just before in 2015 caused major flooding in Holstebro city. It was not a new thought for Herning to collaborate with Holstebro Municipality and Ikast-Brande Municipality to find common solutions to the problem in the local area when water levels in the Storå River increase. The Storå River is 104 kilometres long and has a large hinterland. In case of heavy rain, the large amounts of water flows through Ikast-Brande Municipality through Herning and further on to Holstebro. Sometimes, Holstebro is flooded and both residents and shops are threatened by the water. In 2015, Holstebro Music Theatre was damaged. Damages caused by flooding are expensive and have major consequences for those living close to the river.

The three municipalities know that they have to collaborate to find common solutions. It is no use that Herning Municipality "send on" the water to Holstebro causing flooding. Instead, the municipalities have joined forces to find solutions to how to collect the water in open land.

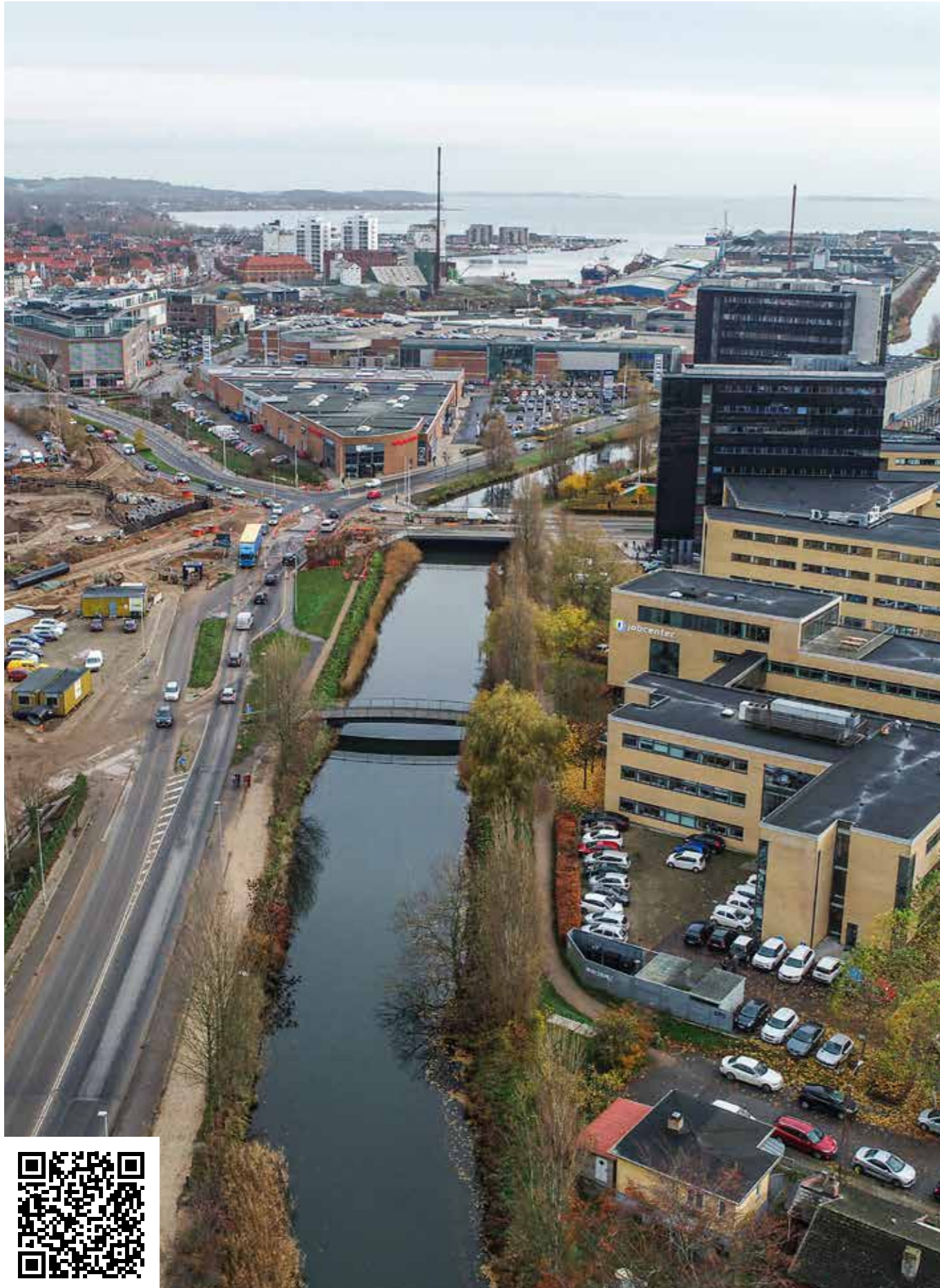
Already before the Coast to Coast Climate Challenge project was launched, the municipalities had contacted a number of farmers who were committed to try to solve the problems with the Storå River. Thus, it was obvious to start the sub-project C13 based on this collaboration.

In the northern part of Herning, two farmers have agreed to let the municipalities flood their meadows in a controlled manner. In these two areas, the water is either retained by a dam or in another way.

When it rains heavily in the winter, the municipality can store the water temporarily on the meadows of these two farmers. It is then possible to measure the effect of the retained water and if it damages the surrounding areas. The project will also show what it takes to control the water. The next step is to make calculations in the area based on data from the project.

The three municipalities hope that a project like C13 can inspire other municipalities and the government to work with similar types of climate adaptation. The project shows that you can collaborate with farmers without spending a fortune and without taking major agricultural areas out of production.

There are no animals on the meadows in the winter and it will thus have no consequences for the farmers that their fields are flooded. The municipalities can use the meadows to make climate adaptations without burdening landowners financially. On the other hand, there is no reward for the farmers by participating in the project; participation is on a voluntary basis. The nature will benefit from being flooded from time to time as it strengthens the biodiversity of the flooded areas. In the future, landowners may be compensated if money is allocated through the National Budget. So far, the only reward is the joy of commitment and giving a helping hand.



Scan to watch interview about C14

C14

HORSENS CITY CENTRE

Horsens was founded in the Viking age and is among the oldest cities in Denmark. At that time, the city was well protected from the weather located at the head of Horsens Fjord. Today, the beautiful location by the water makes the city more vulnerable to climate changes. When the water level in the fjord rises, the risk of flooding of the city increases.

Two things make Horsens city particularly vulnerable to climate changes. First, the watercourses Bygholm Stream and Dagnæs Brook both flowing through the city; second, the special terrain in Horsens. In heavy rain, the water collects at the city slopes; the water flows down and collects in the low-lying part of the city. When the water level in the fjord is high at the same time, neither water from the streams nor rainwater can flow into the fjord, which causes flooding of the city. During storm surges, the old part of the town is particularly vulnerable, while cloudbursts threaten the residential areas causing flooding of houses and gardens. In sub-project C14, Horsens Municipality works on finding out how to balance the increasing amounts of water, which are already present in the city.

One of the things the municipality has to consider as a part of this project is that Horsens is a city that grows very fast. Many people currently settle in Horsens, and the municipality must ensure that the climate adaptation is adjusted to the development of the city. When experiencing this growth, the infrastructure is challenged, and the city is planning to e.g. establish a ring road.

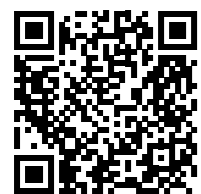
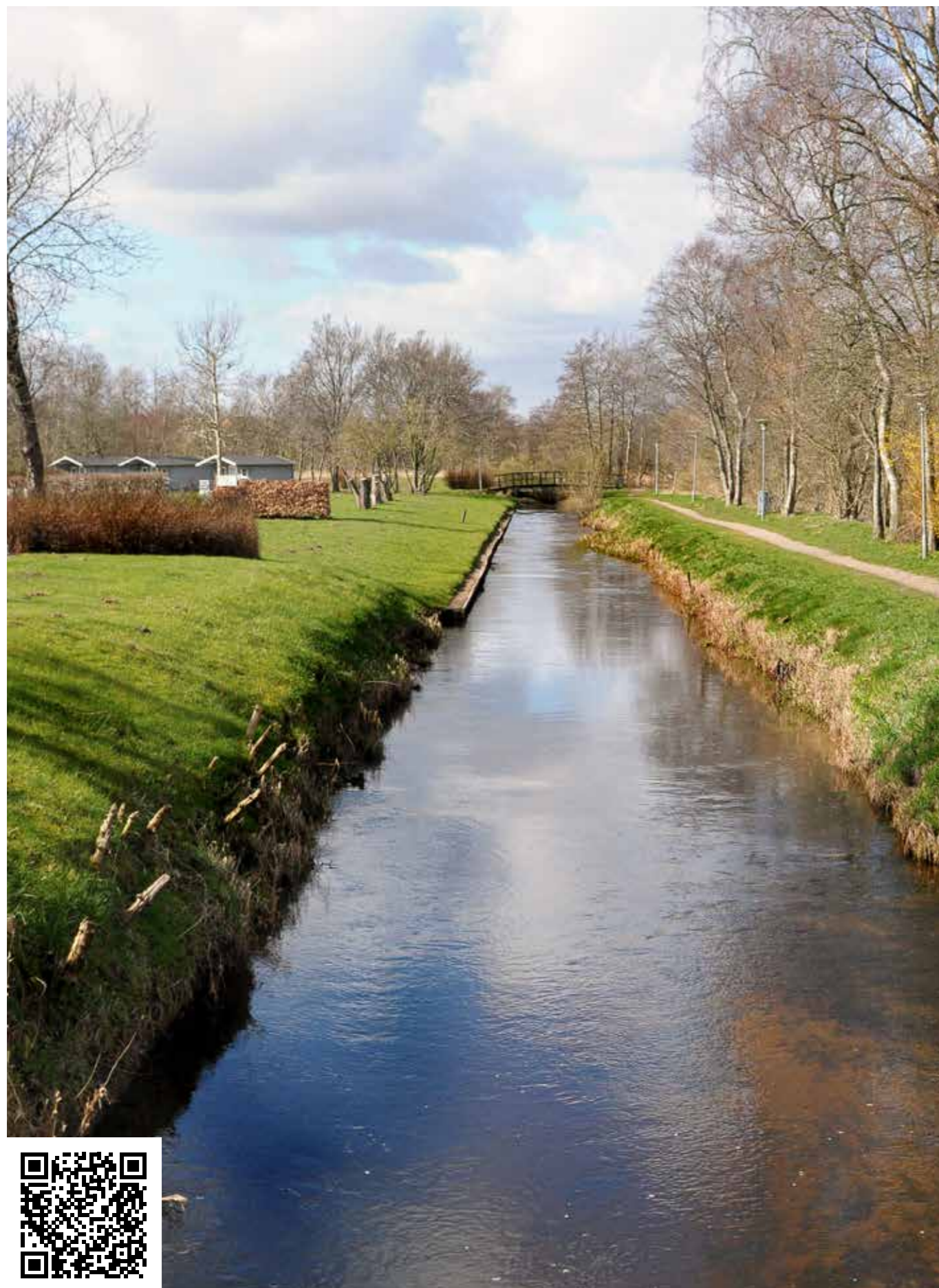
In this connection it would be obvious to investigate if the ring road could work as a kind of flood

protection if elevated to 2.6 m - this is the level local politicians have decided will protect Horsens against future flood surges. In addition to keeping the water from the fjord out, a road embankment will also contribute to manage rain and water from streams inside Horsens city.

Overall, the municipality must keep one step ahead of the major changes in the city. In case of heavy rain, it is no longer possible to manage the water in the underground piping system. The new parts of the city must be planned in a way that collects rainwater e.g. in an area where it does not do any damage before channelling the water through the piping system.

The municipality already has extensive knowledge of flooding of the city and the first phase of the project has been very focused on obtaining a better understanding of the problems caused by the water in the streams. In collaboration with the water utility company, Horsens has designed models which can calculate where the water will collect. This collaboration with the local utility company has been decisive for the project as the utility company has the systems and technical know-how needed by the municipality.

In phase two, the municipality will look further into the storm surge problems and investigate how to manage the water in the inner city. Moreover, the technical approach to the project is now spreading into city planning departments to be turned into specific projects. The big challenge is that the city develops so fast that all climate solutions must constantly be included in the planning.



Scan to watch interview about C15

C15

CLIMATE ADAPTATION IN HEDENSTED AND TØRRING

Tørring and Hedensted both experience that rain-water from the two towns and the surrounding areas flow into two large rivers, Gudenå River and Gesager River. Gesager River is already under pressure, as the area passing Hedensted is flat making it difficult for the water to flow. Also, Gudenå River is pressured as it drains off a large rural area before reaching Tørring. The two rivers are already pressured and when the amount of rain increases in the future, the rivers will have increasing difficulties draining off the water.

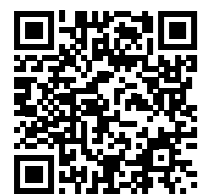
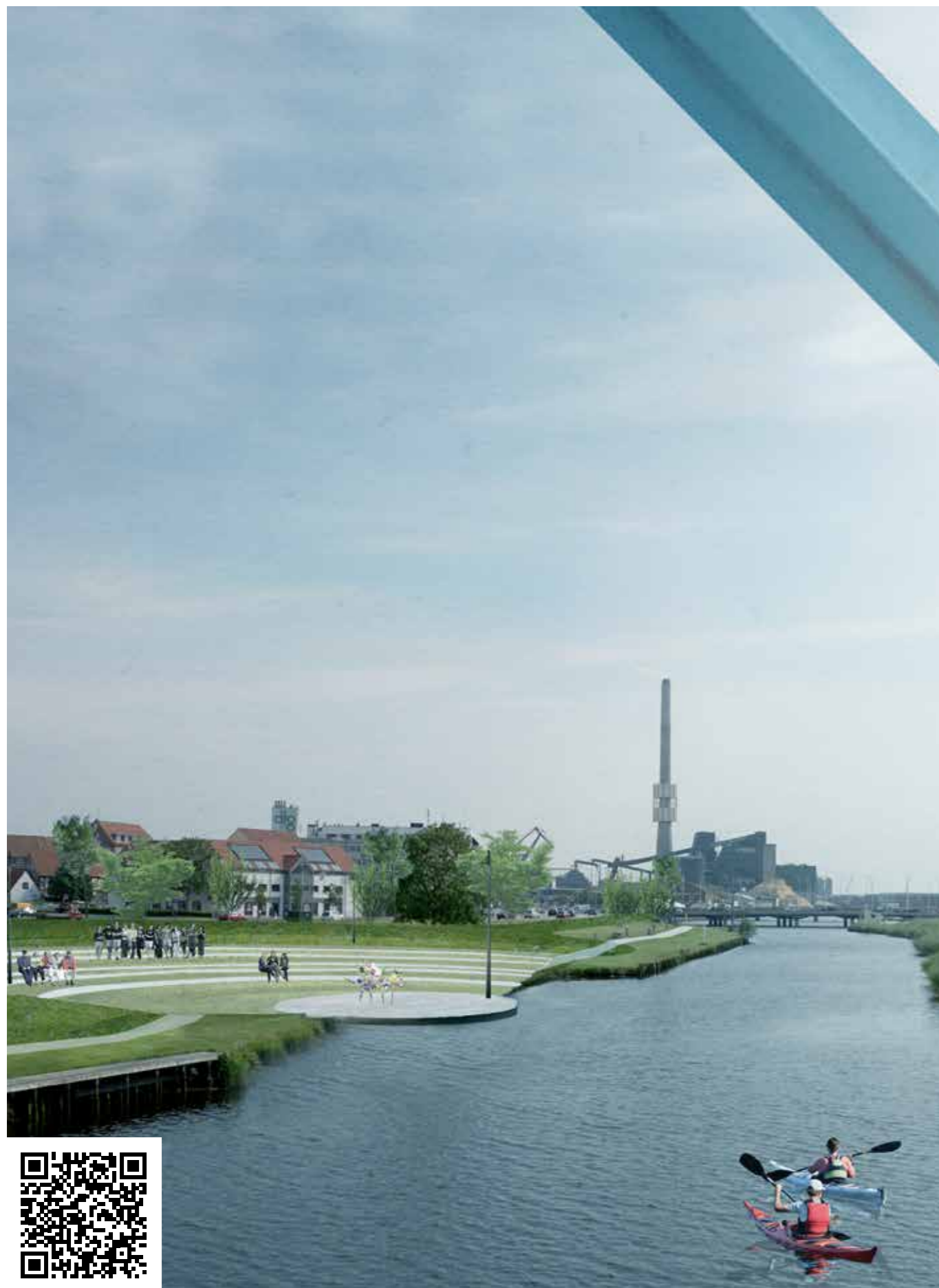
To explore the problems and find possible solutions, Hedensted Municipality has initiated sub-project C15, which includes all interested citizens in the local community. The municipality finds it important that the local residents understand that both towns and rural areas need to make an effort to solve the climate problems. For many citizens it would be natural to think that it is fine that the water is just delayed in the rural area, but it is not that easy. A large rural municipality like Hedensted has to take all interests in rural and urban areas into account and they cannot include too much farmland. Thus, some of the climate challenges must also involve the urban areas.

The sub-project focuses on including citizens in the climate adaptation and providing added value to the local community through the solutions. The municipality has e.g. made a value catalogue describing the added value of different types of climate initiatives. The municipal calculation models are able to show which areas will be flooded by heavy rain. Citizens must assure the quality of the models by confirming if the water is actually located as predicted by the models. Because the

citizens possess the specific knowledge to point out where water is a problem.

Before the municipality starts to come up with solutions, they ask the citizens for suggestions and that has given the project great value. A local school suggested that the municipality collects the water on the school premises to make a water-hole, which can be used for teaching. School children can catch tadpoles and study the water-hole. In this way, the project creates added value for the local citizens. Another suggestion was to store the water caused by heavy rain on a football field which is not in use. Outside the town there are fields which can be transformed into new wetland areas for recreational activities.

The municipality has chosen to be objective and allow the citizens to come up with all kinds of suggestions without excluding any of them. Innovative thinking is needed, and the next step is to find out which suggestions can be implemented in practice. The calculation model is finished and in the next project phases, citizens' suggestions will be implemented in the model. This gives the municipality an idea of the amount of water they are dealing with and how effective the suggestions are on a long-term basis. Later, Hedensted Municipality plans to implement some of the projects in a number of test areas. The municipality hopes to find solutions which can be used on a broader scale by testing different suggestions in smaller parts of the local community.



Scan to watch interview about C16

C16

THE CLIMATE RIBBON

Traditionally, flood protection creates a barrier between water and urban areas. In sub-project C16, Randers Municipality works with the Climate Ribbon project to avoid this particular scenario when the city will be protected against future storm surges. The Climate Ribbon is a green area running along the Gudenå River through the city of Randers and it will work as flood protection in the future - without separating the city from the water and nature.

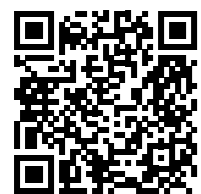
The Climate Ribbon is a part of a city development project "City to the water", which aims to make Randers an attractive river city with many scenic areas. The more than six-kilometre green corridor connects the two natural resorts to the east and west of Randers and at the same time it will protect the city from flooding and storm surges. The Climate Ribbon is an important part of the city development by integrating harbours, green city spots, infrastructure, city life and buildings in the climate adaptation in Randers. The vision is that future climate adaptation will respect the unique nature of the city.

In this sub-project, Randers has attached great importance to including the citizens by inviting them to visit the so-called harbour box, where different architectural companies present their ideas for the Climate Ribbon. In addition to getting new ideas and comments from the citizens, the municipality has clearly felt how important the climate project is to the citizens of Randers.

In the first phase of C16, Randers has made specific innovative climate solutions and the next step is to realise the projects. The municipality plans to start with an open grass field in the city

centre, Justesens Plæne, which is frequently used by citizens, e.g. by students when celebrating finishing school and for the city annual festival, Randers Ugen. The green area is located close to the Gudenå River and traditional climate protection would be to build a 2.5-meter dike to protect the grass field from the water. If the municipality chooses to build the dike further back and closer to the road, it can protect the historical part of the city against flooding, act as a shield protecting people from road noise, open the area and make it easier and more inviting for visitors to get really close to the water. Moreover, if the dike is placed further back, it does not have to be as high as if it was closer to the water.

Another part of the project involves the gradual relocation of the city harbour, which will move from the city centre to facilities east of Randers over the next years. This relocation will make room for new recreational areas in the city centre close to the Gudenå river. As a bonus, the area will have an improved ecosystem when freshwater from the river and seawater from the fjord meet and create a new water environment. The municipality hopes that the new ecosystem will attract new species of fishes, birds and insects. In this way, biodiversity will be closer to the city and the citizens in Randers will have new recreational areas close to the city centre.



Scan to watch interview about C17

C17

THYBORØN TOWN AND HARBOUR

The fishing and harbour town Thyborøn on the west coast of Jutland is challenged by water in many ways – high groundwater level, cloud-bursts, long-term rain and risk of flooding from the Limfjorden and the North Sea. In addition to the threat by weather conditions, the town is further challenged by sinking – in some places up to 1 cm annually. Land subsidence is an increasing challenge for the town. This increases the risk of increasing groundwater levels and flooding of the town. Moreover, subsidence also causes underground drain and water pipes to collapse in the town.

In sub-project C17, Lemvig Municipality in collaboration with Lemvig Utility and Wastewater Company has developed a dynamic model, which maps the water-related challenges of the town. The model describes how the groundwater level is affected by seawater, wind and subsidence in the town. Subsidence is not a unique problem to Thyborøn, but the geology of the town makes the problem highly complex. Large parts of the town are built on a type of soil that is more likely to cause subsidence than other types of soil. When the town is sinking, the underground pipes collapse – pipes worth millions of DKK risk being damaged. The lifetime of a water distribution system ought to be 100 years; in Thyborøn it is about half that time.

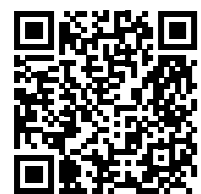
The first part of the sub-project is to get an overview of the conditions. Which pipes are in the ground and how do they work? How does the water flow? What happens when it rains and where does the water collect? The project is based on the Dutch 3Di model, which can make "what if" scenarios by simulating how the water will react

and which factors can affect the water. What happens if e.g. a storm water reservoir is built, a canal or a large pipe? Would this solve the problems? Concurrently, the project has also mapped where subsidence will occur and thus where pipes will collapse. By use of so-called reflectors developed by a local company, it is possible to know exactly where the pipes collapse using satellite measurements.

One of the next steps is to find out what to do about the collapsed pipes. The municipality and the supply company are close to finding a solution to this. Using the dynamic 3Di model, they can assess which methods would be most adequate.

Regardless of how C17 ends, one thing is certain: The work is completed in collaboration with a landscape architect to ensure that solutions are not only technically adequate but will also beautify the town. The same sea and water threatening the town has been the livelihood of the people in the area for more than 100 years. Water and Thyborøn are closely connected and citizens are used to the close contact to the nature. Thus, it is important that the project creates added value for the town.

Thyborøn strongly focuses on tourists, and the project should contribute to improve nature experiences for visitors and local residents. An example could be canoeing in the lagoon area south of the town. Basically, it is important that citizens can get close to the water in the town, by the fjord and the sea, and that the town is protected against climate changes at the same time.



Scan to watch interview about C18

C18

CITIZEN-DRIVEN CLIMATE ADAPTATION IN JUELSMINDE

Juelsminde is a small town in eastern Jutland stretching to the sea with the Kattegat on the one side and the Little Belt on the other. Juelsminde is a low-lying town surrounded by sea and is thus particularly vulnerable to future climate changes. The coastline is low and in some parts of the town elevation is 0; if the water floods the area it can cause considerable damage. According to calculations from the Danish Coastal Authority, a water level of 1.8 m can cause damages amounting to DKK 2.2 billion in Juelsminde alone.

Both home and summer house owners, business and industry will be affected by climate changes such as flooding of basements and problems draining off rain and wastewater. Moreover, the changes have considerably affected how and where it is possible to build new residences in the future. More than 1000 buildings in the area are low-lying and risk being flooded.

To find solutions to how to protect Juelsminde from climate changes, Hedensted Municipality has initiated two concurrent projects – a scientific and a citizen-driven project. While VIA University College makes scientific measurements in the area studying the interaction between sea water and groundwater, the municipality has mobilised citizens and the business community. In the citizen-driven part of the project, Hedensted Municipality has turned the usual process upside down: Instead of starting the climate project at the desk and establish a dike association, the municipality started by establishing the dike association. In this way, an appointed group of citizens was ready to collaborate already from the start of the project.

A large group of people at a public meeting showed an interest in the project and wished to be a part of the working group dealing with climate adaptation of the town. A group of 27 citizens from the working group was reduced to nine persons, broadly representing the citizens of Juelsminde. This group will define a common understanding of the climate changes in Juelsminde and present suggestions for solutions ensuring that the town can continue to develop.

In collaboration with the Danish Coastal Authority and Realdania, a business association with the purpose of creating quality of life through the built environment, Hedensted Municipality is now looking into different solutions to the climate issues in Juelsminde. After this, the dike association will decide which ideas to work with and adapt them to fit the needs of the town. The municipality trusts the citizens with knowledge of the local community to make these decisions.

The Coast to Coast Climate Challenge project has been a big inspiration in the first phases of the sub-project. A study visit to Holland has inspired the municipality on how to collaborate with the citizens in Juelsminde. Inspired by a Dutch project, the municipality now contacts citizens directly if the citizens are dissatisfied or feel neglected in the process. This has given good discussions and exchanges of experiences and everybody has felt they have been taken seriously.



Scan to watch interview about C19

C19

LOCAL DIRECTION OF FLOW OF RAINWATER USED AS RECREATIONAL ELEMENTS

The unique nature at the island of Samsø is an important factor in the municipality's effort to protect the island from current and future climate changes. The nature and the biodiversity are included when considering how to protect against increasing amounts of heavy rain and solutions involving recreational facilities are paramount.

Sub-project C19 has two main purposes: One is to manage the water caused by heavy rain; the other purpose is to use the water for recreational purposes instead of just trying to get rid of it. By local direction of flow of rainwater, Samsø Municipality will use surplus water to create added value through establishment of recreational areas and other initiatives increasing the biodiversity of the island. Collection of large amounts of rainwater may also benefit farmers on the island. Generally, Samsø gets a lower amount of rainwater than other parts of Denmark and during extreme heat in the summer, it is often difficult for farmers to irrigate their crops due to the shortage of accessible water on the island. In dry periods, the farmers have to apply for a dispensation to pump up extra water from the field crop irrigation systems. This is very costly for the farmers. That is why the municipality is looking for places to store rainwater until the farmers need it.

In the first phase of the sub-project, Samsø Municipality has made hydraulic measurements on the island and outlined different climate scenarios. In this way, they have been able to analyse where to place the catchment ponds for storage of rainwater. The biggest climate challenges on the island happen when a period with substantial amounts of rain pressuring the small streams is combined with a high water level

making it impossible for the rain to flow through the streams. Instead, the water is pressured into the hinterland.

Some of the focus areas are Sørenden, Tranebjerg Mose, Besser Made and Samsø Golf Club. The four locations share a huge hinterland and it makes sense to find a common solution.

At the golf club, it is possible to let the water from the current stream run across the golf course and maybe make a reservoir catchment on the other side of the golf course. In other parts of the area, new catchment ponds can create new recreational areas benefitting the bird life and creating a richer biodiversity.

Another benefit of the project is the improved energy efficiency. The pumping station releases 2.5-2.8 million cubic metres of water into the Kattegat, and in peak periods the station has an extremely high consumption of power. By storing the water, the pumps do not have to work so hard. Another benefit concerns the former seabed areas. Today, they consist of peat constantly releasing carbon dioxide. By flooding these areas with water, the release of CO₂ will stop.



Scan to watch interview about C20

C20

AQUAGLOBE

One of the two beacons in the Coast to Coast Climate Challenge (C2C CC) is AquaGlobe in Skanderborg. The task of this innovative water centre is to find and deliver solutions to ensure access to clean water for everybody. AquaGlobe is a collaboration between Skanderborg Utility Company and 15 different partners; some of the partners are major stakeholders in the water business such as Kamstrup, AVK, Suez and Grundfos. One of the purposes of AquaGlobe is to test, develop and optimise new products for the partners; on the other hand, the products of the partners contribute to making the systems at Skanderborg Utility Company more effective, cost-efficient and sustainable.

In addition to collaborating with the 15 partners on new technologies, AquaGlobe is also used as showroom and a place to inform about the projects in the entire C2C CC project. All the sub-projects in C2C CC use AquaGlobe as a platform to inform about their efforts in climate adaptation. One of the next steps in C20 is that AquaGlobe together with the Climatorium and Central Denmark Region visits all the sub-projects in the C2C CC project to find out how they can help municipalities and their collaborators to inform and communicate about the many climate projects.

AquaGlobe has already had an exhibition about sub-project C24 involving Aarhus University and Moesgaard Museum. The sub-project investigates the association between climate changes and cultural heritage and how focus on our history can engage citizens in climate issues. The exhibition shows how scientific methods can illustrate how the climate has changed historically. This could be illustrated by the growth rings of old trees or ice

cores from the ice cap showing how the climate and nature has developed and changed over time. The exhibitions at AquaGlobe do not have to be static, they can tour around the country. An example of this was the National Conference on Climate Adaptation in Horsens in 2019.

In addition to the exhibitions on tour and the physical exhibitions in the building, AquaGlobe can also help to inform about the C2C CC projects online. At the Skanderborg Utility Company website, citizens and other interested can read about the current climate adaptation projects in Skanderborg Municipality. Right now, you can find texts, photos and maps that tell about and visualise a project to protect the area around the Skanderup Brook from flooding.

In the same way, AquaGlobe will in the future be a platform for informing about the sub-projects in the C2C CC project.

By being a part of the C2C CC project, AquaGlobe has been included in several strong networks on climate adaptation. Especially, the other beacon in the C2C CC project, the Climatorium in Lemvig, has been beneficial as both projects focus on gathering the same stakeholders at the same geographical locations. AquaGlobe works with fresh water and the hinterland; the Climatorium works broadly within green transition with focus on the coast and sea water. In this way the two beacons collaborate and supplement each other creating and communicating good climate adaptation solutions in Denmark.



Scan to watch interview about C21

C21

CLIMATORIUM

In Lemvig, they work at full throttle to finish one of two beacons in the Coast to Coast Climate Challenge (C2C CC) project, the Climatorium. The innovative climate centre is situated in an area facing the most severe climate challenges.

The Climatorium is a direct effect of the C2C CC project and the idea was already formed at the beginning when meeting with Central Denmark Region in 2015. The Climatorium is based on a so-called quadruple helix model where universities, private and public companies and the civil society collaborate to find solutions to a problem. Four universities participate in the project and a number of private companies have shown an interest in the Climatorium.

A number of workshops have already been held to show citizens how the project has progressed and what they can expect from the Climatorium. In this way, citizens are included and engaged from the start of the project.

The climate centre is established as an association where citizens, authorities, companies and knowledge institutions can meet. One of the tasks of the Climatorium is to inform about the different sub-projects in C2C CC. This is done through teaching and exhibitions, which may consist of small films and virtual reality encouraging citizens to come out and take a closer look at the C2C CC sub-projects.

Many of the projects at the Climatorium are rooted in the local community. The Climatorium e.g. is trying to find solutions to the challenges faced by Thyborøn concerning subsidence. The many subsidences in the town occur because Thyborøn is located directly on the former riverbed. This

means that the town sinks 2-7 mm every year causing considerable damage to the underground drainage system. In collaboration with a local company, the municipality has set up so-called reflectors using satellite data to monitor where subsidence will occur and where they risk damaging the drainage system.

The Climatorium helps to communicate climate solutions from local companies, to develop their products and export them to the rest of the world. In this way, climate challenges in Lemvig contribute to creating new jobs in the local community and develop new solutions, which many be useful in both Denmark and abroad. The Climatorium is already becoming an export article. In 2018, a delegation visiting from New Zealand was inspired by the project in Lemvig and the hope is that the city of Nelson in New Zealand will get its own version the Danish Climatorium in the future. Until then, the plan is that the two cities on two continents collaborate and share the knowledge they can collect on climate and climate changes.

The physical building in Lemvig is finished in August 2020, and the opening will be marked by a climate conference. The Climatorium is available to citizens and companies. The building has office spaces and an exhibition area communicating knowledge on both climate changes and climate solutions.



Scan to watch interview about C22

C22

PERMEABLE ROAD SURFACES

Already a few months after initiating the Coast to Coast Climate Challenge (C2C CC) project, Hedensted Municipality in collaboration with VIA University College in Horsens started establishing the Climate road, which is a 50-metre stretch of road in Dalby outside Hedensted, to manage rainwater in a new way.

The innovative road is both a climate adaptation solution and a way to prevent climate changes. The road can direct and collect large amounts of rainwater after storm surges while using the rainwater for green energy in buildings in the area by installing underground geothermal heating pipes. Moreover, the Climate road is also an ordinary road in the residential area.

The Climate road is used to manage rainwater in places where other solutions for climate adaptation such as lack of space for rainwater catchment ponds have failed. It does not take up extra space compared to an ordinary road and is a very useful solution in densely populated residential areas where space is limited, and the rainwater is inconvenient for the local citizens. In an ordinary asphalt road, the rainwater is directed away from the road; water on the Climate road, which has a so-called permeable coating, seeps down through the asphalt to a reservoir with room for storage of large amounts of water. In this way the municipality can avoid straining the drainage system during heavy storm surges causing flooding of the area.

The sub-project is also testing how energy in the rainwater can be used for heating of the connected buildings. The Climate road in Hedensted is equipped with geothermal heating pipes, which are warmed up by the rainwater seeping through

the asphalt. The more rain, the more heat the road can produce. The energy from the rainwater is used to for heating of a childcare centre on the Climate road in Hedensted.

The sub-project is a close collaboration between Hedensted Municipality and VIA University College in Horsens providing the necessary knowledge and data. Moreover, students at VIA University College have been involved in several student projects connected to the Climate road.

The experiment with the Climate road goes much further than from Horsens to Hedensted. Through the C2C CC project, the project has spread beyond the Danish border. The idea is very popular and in New Zealand, they plan to establish a climate road in 2020 inspired by the Danish project. This sub-project has generated new projects and the next step is to establish a Thermo-road, which is a further development of the Climate road. The new thing is that the Thermo-road can produce cooling. In this way the road can both heat and cool connected houses while managing the water.

In Lemvig, the Climatorium is investigating other ways in which the Climate road can contribute. This is done as a part of a PhD project in collaboration with C2C CC, Lemvig Utility Company, VIA University College, the construction and property development company NCC and Aalborg University. By establishing a test centre similar to the Climate road, the project investigates how the road can remove microplastics from the water.



Scan to watch interview about C23

C23

POTENTIALS FOR INCREASED INFILTRATION

Overall, the risk of flooding in Denmark has increased as a consequence of climate changes in recent years. This is challenging for municipalities when planning and developing new residential areas. In the cities, the large amounts of rainwater are managed in ways that cause as little damage to buildings, roads and drainage systems as possible; this necessitates innovative thinking by the municipalities to find solutions that make sense. In Horsens, the development is fast and in sub-project C23, the municipality collaborates with VIA University College to investigate how to manage rainwater in new property subdivisions in the city. The project investigates the ability of the soil to absorb rainwater, which is also called infiltration capacity.

The large amounts of rainwater risk straining the drainage system in the city and Horsens Municipality will allow the water to be absorbed locally. The type of soil determines whether absorption is the best method. Using geophysical studies, the project maps where and how the rainwater is absorbed in the soil in the different parts of the planned residential areas. These studies show in detail how the soil is composed at a depth of 5-10 metres and can give a precise description of stones and gravel below the surface.

Since the project started, Horsens Municipality and VIA University College have been busy doing field work. They have studied selected pilot areas, made drillings and run infiltration tests. The results of the sub-project have already been used, because Horsens is developing very fast and several of the residential areas have already been built. Decisions on infiltration of the rainwater in the different parts of the residential areas have been based on data from sub-project C23.

The project has not only benefitted urban planning; students at VIA University College in Horsens have gained considerable practical experience and the data generated in the project can also be used for research. Moreover, the analyses and results of the project have been used to write articles and for student teaching resources.

One of the next steps in sub-project C23 is to make instructions describing how the municipality can use the knowledge collected from the sub-project in the planning of new residential areas. The results can e.g. be incorporated as guidelines in the next revision of the local authority plans.

The results can be used by municipalities, investors and property developers as well as by citizens who will get access to a map showing where infiltration of the water is possible. Another step is to study similarities between municipalities, which may result in instructions across municipalities. In this way, this sub-project may also benefit other municipalities in the region and enable them to work in the same way.



Aarhus year 0



Aarhus year 1200



Aarhus year 1500



Scan to watch interview about C24

C24

CLIMATE HISTORY | CULTURAL HISTORY

Talking about climate changes can be difficult for many and it may be difficult to relate to the problems. Research shows that people do not react to intangible numbers and reports, but narratives can make the debate about the climate more present and relevant to the ordinary citizen. There is a clear connection between local identity and historical narratives; Aarhus University and Moesgaard Museum use this connection to inform about and debate climate challenges, solutions and knowledge close to the citizens. Narratives about how human beings have previously managed climate changes can be used as a starting point for discussing future climate solutions, which affect citizens' behaviour and engage them in regional climate adaptation.

The purpose of sub-project C24 is to develop our understanding of climate changes and the cultural impact that climate changes have on our society and our lives. Using archaeological and meteorological data, Aarhus University maps how past citizens in Central Denmark Region have managed climate changes. In this way, it is possible to find small stories related to climate in the region from Skanderborg Lake to the Gudenå River and the coast of Juelsminde. The sub-project establishes an overview of the associations between people, society and climate with focus on the local area. When we know how people have related to and understood previous climate changes and their consequences, it can provide valuable insight into the kind of changes currently affecting our society, culture and minds. According to Aarhus University, it also increases our awareness of the relation between nature and culture, to find sustainable solutions to the climate changes we will face in the future.

So far, the project has resulted in a number of case studies from the region on how climate changes have affected the development of society in the area. This material has been used for different activities e.g. a larger workshop with foreign guests and partners from the municipality. A manual has been made providing specific instructions on how to include the environmental history of the area in current climate adaptation problems. The manual can be used by the other partners in the Coast to Coast Climate Challenge (C2C CC) project as well as internationally. Climate challenges are often similar, especially in Europe but also in the rest of the world.

Another result of the C24 sub-project is a micro-exhibition at AquaGlobe in Skanderborg, where the different C2C CC projects are presented. A number of scientific articles originates from C24 and the project has contributed to a large national project on the history of Denmark (danmarkshistorien.dk).

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Coast to Coast Climate Challenge (C2C CC) consists of 24 subprojects focusing on sea and fjord, watercourses, rainwater and groundwater as well as governance, new tools and innovation.

The project is halfway through and all 24 sub-projects are up and running.

This report is a status of the progress of all 24 sub-projects as well as plans until the project is concluded in December 2022.

