



Second Open Tender for Innovations

Case Study #7: Southern Denmark

Supplementary information

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The Case Study “Wadden Sea Region, Southern Denmark”

The Danish Wadden Sea region is a coastal region that delineates the Southwestern part of Jutland, Denmark. It spans four neighbouring municipalities: Esbjerg, Tønder, Varde and Fanø, which cover a combined area of approximately 3369 km² with about 206.000 inhabitants. Over half of the inhabitants live in Esbjerg municipality. The Wadden Sea, which is UNESCO World Heritage, comprises the largest tidal flats system in the world with a unique biological diversity, including breeding and migrating birds. Its preservation is a high priority and coordinated through a trilateral and transboundary Wadden Sea Plan by the Governments of Denmark, Germany, and the Netherlands.

Flooding from different sources is a critical challenge for all four municipalities, including surface water flooding, riverine flooding, sewer flooding, and rising groundwater levels induced by enhanced river run-off, intense rainfall events, extended periods of rains, generally changing rainfall patterns and combinations thereof. The coastal areas are highly susceptible to coastal flooding and erosion caused by tides and storm surges. The city of Esbjerg and the surrounding areas, including part of the nearby island municipality of Fanø, are among the most flood-prone areas in Denmark as singled out under the European Floods Directive. Dating back to the 1300's, the region has thus been subject to several catastrophic floods from the sea causing widespread damages and thousands of deaths. Consequently, a range of protective measures and strategies for risk management already exist or are planned to mitigate the risks of storms and storm surges. However, due to rising sea levels induced by climate change, it is highly likely that current practices may not even today be enough to protect local communities and their activities. Meanwhile, further climate change impacts in the form of more frequent and intensive extreme precipitation, rising groundwater levels, and even drought are also increasingly being felt.

To enhance resilience to current and future climate risks and abate their consequences for people, cities, socio-economic activities, and vulnerable natural systems, there is an urgent need for filling key knowledge gaps as well as for extensive local development and investments in climate change adaptation, which needs to go hand-in-hand with improved emergency preparedness. This requires close involvement and acceptance from citizens, local stakeholders, and investors. Hence, the specific responsibilities for financing climate change adaptation solutions to manage flood risks from the sea, surface & sewers, watercourses, and groundwater in Denmark belong to a combination of public and private actors, i.e., municipalities, landowners, and utility companies. The responsibility for planning and implementing adaptation measures in Denmark is anchored locally. Under the national Planning Act, municipalities are responsible for preparing risk management plans, adaptation strategies and planning. Meanwhile, local stakeholders like property owners and utility companies are principally responsible for their implementation and financing. In cases, where municipalities decide to implement climate change adaptation, the local government can decide to fund it directly via taxes. In other cases, e.g., where adaptation is funded by a municipality together with a group of private stakeholders, e.g., to build a dike; or it is funded entirely by the group of private stakeholders, a legal principle of “burden sharing” apply, where costs are shared based on the estimated benefits (risks reduced) for different stakeholders.

The Living Lab “Ensuring the wellbeing and protection of people and assets along Esbjerg coastal city and port”

The city of Esbjerg is the fifth-largest city in Denmark with about 72.000 inhabitants and forms the main industrial centre of the area. This includes in particular the commercial port of Esbjerg, which historically was the home of more than 600 fishing vessels, but which today is Denmark’s leading offshore port and a central node for freight transport in Northern Europe. The commercial port is also one of the largest points of disembarkation of offshore wind turbines in the world and is on route to play a significant role for the green transition by facilitating renewables from the North Sea. Accordingly, the city of Esbjerg is a nexus for transport, energy, communication, and other kinds of critical infrastructure, some of which are located in highly flood-prone areas. The Port of Esbjerg is principally responsible for its own safety and largely considers itself protected. Hence, synergies between the port and the city are currently poorly exploited, as there are many conflicting interests.

The highly attractive areas bordering the port and the coast are heavily populated. Due to the strong economic development in and around Esbjerg, investors are currently highly motivated to fund new housing projects, including for the elderly. These are in demand, since living in the city center is increasingly popular. The development of new appealing living spaces in the city center and along the coast and port also supports the municipality’s goal of attracting new inhabitants to the city. In some cases, investors are unaware of the extent of current and future risks of coastal flooding, which may impact their investments. Further, a central part of the area is highly subject to additional flood risks caused by heavy rains and rising groundwater.

Ensuring the wellbeing and protection of people, assets and investments along Esbjerg coastal city and its port is a key priority for the local government. For this aim, a diverse set of stakeholders was brought together to form a Living Lab, including representatives from Esbjerg municipality, the Port of Esbjerg, the local utility company, insurance, emergency preparedness, the local policy authority, local educators, cooperative and social housing associations, an owner of rental properties, investors, NGOs, engineers, and the Danish Coastal Authority among others. All of these stakeholders are affected directly or indirectly by water-related climate change risks within urban areas extending from the port and coast and deep into the city. These stakeholders were identified as being central for both climate change adaptation efforts and for improvement of emergency preparedness towards extreme events.

In the following, we outline the stakeholders’ vision for 2050 and the associated key innovation challenges addressed by this tender for innovations.

The Problem Statement by Stakeholders

Climate change poses several major challenges to Esbjerg, especially in terms of increased flood risk from both single and compound sources. A key challenge, identified by

stakeholders, is the critical need for efficient and sustainable flood risk management ensuring citizens' safety as well as investment safety for both existing as well as future investments in city, enterprises, and other values. The city and port of Esbjerg is facing increased water challenges from "all sides". There is no single actor that will address these challenges in holistic ways at present and this is not likely to change in the future unless legislation is changed at the national level. As a result, climate change adaptation requires deep involvement and collaboration between citizens and actors from both the public and private sectors, including the local government, investors, etc.

The Vision of a climate-resilient Future

In 2050, the city of Esbjerg and its commercial port are resilient to the impacts of climate change, and tightly connected. The area is a lighthouse for other cities in terms of green and sustainable urban and commercial development. The city is thriving, and increasingly attracts new citizens, companies, and investors.

Where people live, or where important values or critical infrastructure are exposed, protection against water from "all sides" has been established through close dialogues and collaboration between citizens, the public and private sectors. This has been informed by tailored, science-based climate information delivered by the national authorities and Danish and international data and knowledge providers.

Green and nature-based solutions and green connection lines contribute to the welfare and wellbeing of the citizens and strengthen biodiversity. They unite different parts of the city and enhance the historical connection between the city, port, and the marine environment. This includes for example the sort of "coast and art" programs, which were introduced in the 2020's. It also includes the newly established Green Flood Barrier (in Danish: "Havnestrøget"), which has become a landmark of the city, and which protects the city against unprecedented storm surges enhanced by sea level rise. Around 2025, a low concrete wall was built along the perimeter of the coastal city and port area to buy the time for designing the innovative green infrastructure including a "green wedge" that ensures long-term coastal flood protection, connectivity between city and coast, while offering significant recreational and commercial value. To make room for the flood barrier, several existing buildings and infrastructure were moved or demolished with broad support from both owners and the general public, who understood the urgency of these actions. Subsequently, the planned flood barrier was refined and co-financed by relevant actors from the public and private sectors.

This development of Esbjerg's Green Flood Barrier exemplifies the way that key climate challenges – even including so-called "wicked problems" – are treated in Esbjerg. Preferred adaptation and mitigation solutions are robust, synergetic, multi-functional and sustainable and embraces new innovations and approaches, including technological, social, and institutional innovations.

Citizens, local businesses, and public sector institutions are supportive and well-informed about climate change, the challenges they pose to Esbjerg and their individual roles and responsibilities with respect to, e.g., increasing climate risks, climate change adaptation and financing. Local citizens, young people, and children are educated at different levels, including in schools, to raise climate awareness, increase local adaptive capacity and instill proper risk behavior. A number of social and technical innovations like the original “climate app” developed for Esbjerg in 2021 to illustrate the water depth suffered due to different climate scenarios using an augmented reality, exploiting advances in artificial intelligence and digital technologies, support the local climate risk education with respect to both adaptation and also emergency response.

Everyone - citizens, knowledge institutions, educators, utility companies, investors, and other contributors from the private and public sectors participates positively and in a coordinated manner to solve the local challenges of climate change and sustainability, in Esbjerg where they can, based on balanced and just economic models. This means that adaptation solutions from the individual property level like rain gardens and green roofs, to city-wide installations like the Green Flood Barrier are effective, cohesive, and synergistic. Individual property owners are aware of their responsibilities, and they refrain from “exporting” their problems to their neighbors. At all levels, the use of ineffective solutions and maladaptation is minimized through meticulous and holistic planning that takes into account near-, medium-, and long-term perspectives.

The Key Challenge for the Second Tender for Innovations

The key challenge for the tender for innovations is to motivate and inform relevant stakeholders and practitioners and to promote a deep engagement from commercial actors, citizens and the civil society in climate change risk management and adaptation, including investments. Without such a holistic and transformative approach, both climate change adaptation and disaster risk management are likely to be suboptimal. Many different actions and activities could contribute to solving this challenge, including social, technical, economical, and governance innovations. Education and increased risk awareness is likely to play a significant role as is the use of digital platforms and techniques like mobile applications/apps, the use of existing and upcoming open data, and AI. Specific areas of action may include but are not limited to:

- Innovations and actions to inform and engage civil society in climate change adaptation beyond the “usual suspects”.
- Improved communication pathways from the authorities to and with citizens during an extreme flood event, for example in terms of education, early warnings, real-time flood forecasts, recommendations and information sharing, data collection and citizen science.

The involvement of the private sector is also crucial, as ambitious climate change adaptation hinges on co-development and co-financing with the private sector. There is, however, currently little information on incentives for the private sector to engage in climate change adaptation with a broader scope (city and society) than just the protection of own assets. There is also an urgent need for improved knowledge of the economic costs of flood events to their business activities. The latter was recently emphasized in the aftermath of the October floods from the east, when countless small companies reported massive, uninsured damages. In this context, specific areas of action may include but are not limited to:

- Innovations that can help motivate businesses and investors to adopt more community-oriented perspectives with a high valuation of co-benefits and social responsibility. Investigation and/or monitoring of incentives for investors from the private sector to engage and invest in urban development and climate change adaptation – with a focus on Esbjerg and the landmark Green Flood Barrier.
- Assessment and collection of data on the estimated and/or realized costs of flooding by industry, small and large businesses, shops, etc.

Innovations should result in measurable impacts and include a plan for evaluation.