Mapping of problem owner challenges and potentials for water technology and climate adaptation in the Region of South Denmark, the Region of Zeeland, and the northern part of Schleswig-Holstein

This English concluding summary by CLEAN is based on two separate reports carried out by CLEAN (Danish report) and Christian Albrechts University in Kiel (CAU) (German report).

The mappings seek to investigate whether the already identified problem owner challenges in the capital region of Denmark (taken from the DTU Smart Water Report), as well as the challenges detected by DANVA and the Danish Water Sector are also evident within the NEPTUN project's program region in Schleswig Holstein, Germany.

Method
A survey was designed as a combined quantitative (questionnaire) survey with subsequent qualitative qualification and elaboration of the results. The content of the questionary is qualified with a pilot group consisting of Billund Water and Wastewater and Fredericia Wastewater and Energy.

Denmark
The survey was sent to 42 water utilities, climate protection offices of municipalities or companies. The survey was answered by 13 problem owners (8 water utilities, 4 municipalities and 1 Region), either on-line (9 answers) or by a telephone in depth interview (4 answers).

Germany
The survey was sent to 33 potential organizations such as water associations, public utilities, climate protection offices of the municipalities, agricultural associations. The survey was answered by 10 problem owners (4 water associations/water procurement association, 2 wastewater utilities, 2 municipalities, 1 region, 1 dike association). The survey was answered by either answering the survey (2 answers from one water supply and wastewater association) or by giving telephone interviews (9 shallow interviews). In Germany the informers in the telephone interview found the survey questions too complexed and difficult to answer without involving many persons from the organization, which was not feasible in terms of capacity, logistics and technology. Therefore, the telephone interviews were redesigned to ask the respondent directly about the challenges present in his or her area, which proved to be more purposeful and led to much more informative conversations.

Conclusion of the design of the interviews: It can be concluded that the total input is covering the target for the survey and the given information are sufficient. The conclusions are based on information from 23 informers instead of planned information from 35 informers. Due to the information above it has only been possible to rank the challenges with the 3 highest scores in each category for Denmark and make a comparing with the results from the German interviews.

Results across the border (Similarities and differences)

The challenges in water supply, disposal and climate change can be summarized as follows. For Denmark it has been possible to rank the challenges in the topics with the 3 highest score in each category. For Germany no clear picture has emerged regarding prioritization. However, the found challenges are well documented from literature. The German challenges below are marked with challenge 4 – 6, unless there is common challenge across the border, which is highlighted with bold and cursive.

The topic, that are most important across the border.

Concluding summary October 2021

Drinking water

1. **Common challenge:** ***Lack of methods for monitoring and securing the groundwater resource and emergency*** **/** supply security at especially the smaller waterworks (DK) ***Lack of concepts and techniques to increase groundwater supply and higher the declining groundwater levels. (D)***
2. **Danish challenge:** Lack of methods for treatment of groundwater/ purification of pesticides and substances harmful to the environment and health in drinking water (DK).
3. **Danish challenge:** Lack of methods of purification at source (DK).
4. **German challenge:** Lack of models to predict when the contaminants in the uppermost aquifers will reach the aquifer for drinking water supply (D).
5. **German challenge:** Lack of detection suited measuring systems in water supply pipe systems (D).

The conclusion is that lack of methods to secure the groundwater resource and techniques to increase groundwater supply is a common challenge across the border. Challenge 2 and 3 have only been highlighted by Danish informers. D-DK knowledge exchange at network meetings or webinars is relevant in these fields due to the circumstance, that Danish experts have developed solutions for these challenges. It is also interesting to hear German experts, if they have solutions on the Danish highlighted challenges.

One innovation collaboration in the NEPTUN project has met the mapped challenge regarding drinking water. This is: 1. Lack of methods to secure groundwater resources and technics to increase the groundwater supply and higher the declining groundwater levels.

Wastewater treatment and sewage systems

1. ***Partial shared challenge: Lack of efficient technologies and valid data for managing and warning water flows in cities and sewer systems (DK, Lack of digitalisation and automation in the wastewater system (D). Need for a sensor-based monitoring system (D)***
2. ***Common challenge: Need for better warning systems and models for differentiated water types and consequences of e.g., cloudbursts in the reception areas. Lack of a hydrometeorological early warning system that can be coupled with existing sensor technology (D)***
3. **Danish challenge**: Lack of effective technologies for overflow management and control

The conclusion is that better warning system in case of cloudburst is a common challenge. The partial shared challenge could be a potential challenge for an innovation project in NEPTUN. Two innovation collaboration in the NEPTUN project have already met the mapped challenges above. This is “Lack of Early Warning systems” and “Lack of efficient technologies for overflow in shared wastewater/rainwater sewage system”. Regarding 3. This challenge is mostly dominant in South Germany, but not in the northern part of Germany (program region), where separated wastewater and rainwater systems are more widespread. The innovation project Carbon and P-reuse in the NEPTUN project is a technology driven project and not one of the topics that the informers in the program region have highlighted even though it is national priority in Denmark as a whole to develop P-reuse from sludge at wastewater treatment plants.

Reuse of industrial water

1. Danish challenge: Lack of opportunities for the use of surplus water from remedial wells

This topic is only highlighted in the Danish mapping.

Concluding summary October 2021

Climate adaptation

1. Danish challenge: Lack of management strategies for climate adaptation systems using weather data, radar data and online sensors (DK).
2. ***Common challenge:*** ***Lack of models and technologies for handling rising groundwater / drought (DK). Lack of concepts and techniques to increase groundwater supply and understand the declining groundwater levels and connection with climate change (D).***
3. ***Common challenge:*** ***Lack of robust sensors and drones for monitoring water quality and water level in connection with cloudbursts and floods from seas, streams and rising groundwater (DK). Need for a sensor-based monitoring system and more digitalization in Germany (D)***

Structural problems water technology and climate adaptation (top 3)

Denmark

- Water utilities and municipalities are limited by economic framework and a demand for efficiency and is less motivated to be a part of development projects.
- Lack of local ambitions about an energy efficient and climate neutral water sector.
- Lack of system integration across data sources, physical facilities, and technological platforms.

Germany

- Poor funding for studies and technical solutions.
- Increasing administrative burden due to more connected municipalities.
- High costs for renovation of sewage system and adaptation to heavy rain events.

The problems of adaptation to climate change are predominantly structural:

- Lack of adequately trained staff
- Lack of holistic thinking
- Tendering procedures do not promote collaborative and innovative solutions

Conclusion technical challenges:

There are identified 2 common challenges, that already are a part of innovation collaboration projects in NEPTUN and 2 common/partial challenges, that can be a starting point for future potential innovation collaboration project in the NEPTUN project because the challenges need technical solutions

Common challenges:

1. *Lack of models and technologies for understanding and handling rising groundwater / declining groundwater level* caused by climate change. (D)
2. *Need for better warning systems and models for differentiated water types and consequences of eg cloudbursts in the reception areas* Lack of a hydro-meterological early warning system that can be coupled with existing sensor technology (D)

3. *Lack of robust sensors and drones for monitoring water quality and water level in connection with. cloudbursts and floods from seas, streams and rising groundwater* (DK). Need for a sensor-based monitoring system and more digitalization in Germany (D)

Partial shared challenges

4. *Lack of efficient technologies and valid data for managing and warning water flows in cities and sewer systems (DK,* Lack of digitalization and automatizaon in the wastewater system (D). Need for a sensor-based monitoring system (D)

Moreover, there are topic where there could be a potential for knowledge exchange on webinars or network meetings. There might be more topics, but as a minimum the identified topics are:

5. Lack of models to predict when the contaminants in the uppermost aquifers will reach the aquifer for drinking water supply. (Danish knowledge can be transferred to Germany)
6. Lack of detection suited measuring systems in water supply pipe systems (Danish knowledge can be transferred to Germany)

Mapped challenges versus started innovations collaborations

In the table below the mapped common crossborder problem owner challenges February 2021 are listed and compared with the already started innovation collaborations 1. Round, May 2021.

Common D-DK challenges	**Started innovation projects 1. Round**	**Innovation project 2. Round (step 1 – Oct. 5.th.)**
Understanding and managing of raising groundwater/decreasing groundwater	• Falling groundwater level at waterworks	
Need for better warning systems and models	• Early Warning systems	
Lack of robust sensors and drones for monitoring water quality and waterlevel		• Use of sensors and drones in climateadaptation
Lack of effectient technologies and valid data to manage and warn for raising waterflow in cities and sewagesystems	• Overflow • Faulty connections	• Modelbased optimization of sewagesystems
	• Carbon and P-reuse	
		• Automatic pumpcontrol at dikes

The deadline for the next innovation collaborations applications step. 1 was Oct. 5 th., where 3 pre-applications were received. It is expected that further applications will be handed in at the final deadline at Nov. 15 th-, so the KPI of 10 innovations collaboration can be reached and the common 4 demand driven D-DK challenge will be reached. The projects “Carbon and P-reuse” and “ Automatic pumpcontrol at dikes” are technology driven projects.

In all innovations collaborations there are a German-Danish representation from the programregion in the project consortiums.

Concluding summary October 2021

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